Popular Science

Founded MONTHLY *1872*

AERO SLED THAT CAN BE MADE AT HOME—SEE PAGE 88

...tupendous Battle Pictures of the "Next War"

$240 in Prizes for Your Practical Ideas

...CEMBER 300 Pictures of New Inventions 25 CENTS

Yes, Sir!

I HAVE to make special trips to supply all the people who want Murads for Christmas gifts.

Have You Learned to Typewrite Yet?

Universal typing is *here*. People are abandoning the slow, tiring task of long-hand writing. How long are *you* going to cling to it, in this world of advancement? Everybody dislikes to receive long-hand letters. And everyone shirks at correspondence when it has to be done the old-fashioned, tiring way. So join the progressive throng—get a typewriter NOW.

Free Trial

We ship the Oliver for five days' free trial. Let it sell itself. Or send it back.

14 Months To Pay

Pay for this Oliver while you use it. Only $4 per month and you soon own it.

$49.50 or $100? Which would you rather pay for a standard typewriter?

For 25 years all standard typewriters have been priced at $100 or over and still are—except the Oliver.

It is the only standard typewriter selling at half. It is the only standard, $100 typewriter being marketed direct from the factory.

Were it not for this simplified selling plan, the price of the Oliver would also be $100 or over. For it is the same fine machine, the finest model we have ever built. Over 900,000 have been sold.

We simply sell the identical $100 Oliver direct from the factory, and subtract all the extravagances of complicated selling. We have found that it is needless to maintain a high army of salesmen and agents. We have found it unnecessary to sustain a costly chain of branch offices in over 50 cities.

The $50.50 you save is the sum that it would cost us to sell the Oliver the roundabout way. Plus a saving made because of the volume of business created by our plan.

Send No Money

We let the Oliver sell itself. We ship it to you for free trial. Then you can compare it with other standard typewriters at $100 or over.

You become your own salesman. You are the sole judge. No anxious solicitor will urge you. In the privacy of your own office or home you can decide for or against the Oliver.

If you want to own it, send us $49.50 cash. Or if you wish to pay for it in installments, send us $3 after the trial period, then $4 per month until $55 is paid.

You can readily appreciate that it takes a super-typewriter to sell itself.

No test could be severer. Remember, there need be no fluent salesman to urge you.

If you decide against the Oliver, ship it back at our expense. We even refund the outgoing transportation charges, so that you do not risk one cent in the test.

Now we ask you, would you rather pay $50.50 additional and not get a finer typewriter? Would you care to support a $100 price for the Oliver, and get nothing tangible in return?

Or don't you agree that our new way of selling is logical? Doesn't it appeal to your common sense?

SAVE $50.50

How to Save

The coupon below brings you EITHER a Free Trial Oliver or Further Information. Check which you desire.

This is all you have to do to save the $50.50. Without such a plan, you'd have to pay $100 or over.

But this way you not only save—you get the finest typewriter that can be built by a leading maker. It comes fresh from the factory, our latest and best model, a 25-year development.

Check the coupon *now* and mail it in.

The OLIVER Typewriter Company
1109 Oliver Typewriter Bldg., Chicago, Ill.

THE OLIVER TYPEWRITER COMPANY,
1109 Oliver Typewriter Bldg., Chicago, Ill.

☐ Ship me a new Oliver No. 9 Typewriter for five days' free inspection. If I keep it I will pay $55 as follows: $3 at the end of trial period and then at the rate of $4 per month. The title to remain in you until fully paid for. If I make cash settlement at end of trial period I am to deduct ten per cent and remit to you $49.50.

If I decide not to keep it, I will ship it back at your expense at the end of five days.

My shipping point is.....

☐ Do not send a machine until I order it. Mail me your book—"The High Cost of Typewriters—The Reason and the Remedy," your de luxe catalog and further information.

Name.....

Street Address.....

City..... State.....

Occupation or Business.....

Some of the Famous Users:
New York Central Lines, Hart, Schaffner & Marx, U. S. Steel Corporation, N. Y. Edison Co., National Cloak & Suit Co., Morris & Co.—and hundreds of others.

Now, why not obviate the Watchful Waiting for decay to manifest itself in out-of-doors woodwork by making everything of Cypress, "the Wood Eternal," in the first place?

Well, sure enough—why not go ahead and obviate? This kind of foresight is Some Obviator when it comes to Lumber Repair Bills.

It is possible that we might have a booklet you could use to advantage—we have 43 of them in the Cypress Pocket Library. Some have plan-sheets—big and practical and artistic—and exclusive—and they cost us something—you nothing. Volume One contains the list. Also what the government of the U. S. A. says about Cypress, "the Wood Eternal." Our address is below. What is yours? Is it all right to ask?

All-round Helps Department

Southern Cypress Mfrs.' Ass'n.

1249 Poydras Building, New Orleans, Louisiana
1249 Graham Building, Jacksonville, Florida

Contents of the Home Workshop

A department for the man who works at home with tools

A Radio Receiver for Everybody 84
To Make a Pair of Balances 85
Attractive Ornaments from Clay 86
Moving Shadow Pictures 86
Dry Cells in the Country 88
Oil Filter for Farm or Shop 88
Speed Wrench of Simple Construction 88
Build Your Own Air-Driven Sled 90
Christmas-Tree Candle-Holders 91
A Woodbox Under the Stairs 91
New Prize Contest 92
Bench-Hook and End-Wood Planer 92
A Boring-Table for the Small Lathe 94
Piping a Garden Spring 94
To Make a Doll's House 96
Wood Puzzles that Will Interest 97
Making a Glue-Joint Invisible 97
Best Idea Contest 98
To Prevent Breaking a Small Drill 98
Housewives Will Find This Baker Useful 98
Improved Spur for Stump-Boring Auger 99
Can-Opener Made from Strap-Iron 99
Using the Discarded Gasoline Barrel 99
Useful Things to Do at Home 100
Shoe-Polishing Support 101
If Your Pipe Fails to Draw 101
Make This Disk-Grinder 102
A Fountain for the Poultry 102
Try a Rubber Hose on the Grease-Gun 103
Transforming a Kettle into a Glue-Pot 103
To Prevent Wood-Screws from Loosening 103
Weather Strip Will Adjust Itself 104
Indirect Light from Old Wash-Basin 104
Old Sink Forms Gas-Stove Foundation 105
Homemade Cook-Book Holder 105
Pistons Become Serviceable Bench Centers 106
Vulcanizing Molds Can Be Made at Home 106
Improvised Clamp for Home Use 106
Ornaments of Hammered Brass 107
Wide-Swinging Gate for Farmyard 108
Novel Spool and Twine Holders 108
Spinet Transformed into Bookcase and Desk 109
Ruler that Will Not Slip 109
Telephone Warns of Rain 110
One Method of Removing Obstinate Staple 110
Screw-Holder for Starting Screws 110
Hinged Tailboard with Eccentric Lock 112
Hallstand Built from Old Easel 112
Carburetor for the Coal-Range 112
Drawing May Cause Error in Machining 112
Reflected Light for Indoor Pictures 113
Winter Use for Electric Fan 113
Cleaning Under Surface of Boat Hull 114
Straightening Cotters to Bring Points Together 114
Stamp-Pads Made of Type Ribbons 114
Pulling Posts Rendered Easy by This Method 115
Preventing Standing Saw from Sliding to Ground 115
Attach a Hand Guard to the Wheelbarrow 116
Handy Nozzle on Hose for Filling Radiator 116
Use Old Books for Filing 116
Neat Room by Means of Gaslight 118
Reference-Book Pages Held with Tire-Tape 118
Providing Soft Nose for Peen Hammer 119
Making Cork-Handle for Fishing-Pole 119
Emergency Clothes-Line Pulley 119
How Leather Straps Can Be Made 120
How to Make Your Own Wire Terminals 120
Automatic Photo-Print Washer 121
Equip Tenon-Saw with Guard 121
Furniture Polish Renews Auto Lights 121
Cats Can Be Kept Off the Back Fence 122
Pipe-Pulling Tool Is Useful on the Farm 122
Old Skylight Serves as a Hotbed 123
Collapsible Stepladder for Home or Shop 123
Tip-Up for Fishing Through the Ice 124
Finger-Nail File Used as a Match-Scratcher 124
Carrying Storage Battery with a Chain 124
Drainpipes May Be Used as Porch Supports 125
Quick Repair of Broken Motorboat Muffler 125
Lawn-Mower Becomes a Countershaft 126
Pail and Tub as Improvised Air-Compressor 126
For Repairing Furniture Rungs and Legs 127
Sharpening Tool Will Concave Ice-Skate 127

What Is that Question You Couldn't Answer?

Let Popular Science Monthly answer it for you. Our Service Department will gladly supply information on problems of general science or on home-workshop perplexities. It is conducted for your benefit. Read page 53.

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"The First Month I Earned $1000"

—And he might have remained a farmhand

A $50 a month job as a farmhand one day—out of a job entirely the next—and then a position that paid him $1,000 the very first month! Such was the sky-rocket career of Charles Berry of Winterset, Iowa. And more remarkable still, it all came about as the result of a sunstroke!

How long he might otherwise have remained a farmhand, no one can say. Certainly, however, his work held little promise of better things for the future. Then one day as Berry followed his plow across the fields, under the scorching rays of a burning sun, he suddenly collapsed in his tracks. Sunstruck! He was forced to quit.

Subsequently he found employment in a variety store. His reward for long and tedious hours of clerking was $18 a week.

CHARLES L. BERRY

Out of the Low Pay Rut

Not a very remarkable job—but it meant the turning point in Berry's life, for it brought the discovery of the way to big earnings. Berry had been noticing the Salesmen who came to call on the proprietor of the store. He noticed their prosperous appearance; they stopped at the best hotels, travelled on the fastest trains; and there was an independence and variety about their work that made their careers look like one long vacation compared to Berry's job.

One day Berry fell into conversation with one of the Salesmen.

"Yes," the latter said in answer to his question: "Salesmen **do** make big money. And here's the reason: the success of any business depends upon the amount of goods sold. The man who sells is producing profit for his firm. His services are in demand everywhere. He commands big pay wherever he goes. And there is no limit to what he can earn."

"But a man must have natural ability to become a Salesman."

"That's an old, out-of-date notion," the Salesman replied. "Salesmanship today is a science—it's just a matter of knowing how. Take myself for instance, I owe my success to the National Salesmen's Training Association. This is a wonderful organization of top-notch Salesmen and Sales Managers formed just for the purpose of fitting men for success in Salesmanship. It enables anyone to become a master of all the Secrets of Selling in his spare time at home. Why, it has made Master Salesmen out of men who had previously been clerks, bookkeepers, mechanics and so on. If I were you I'd write to the N. S. T. A. Just ask them to tell you about their system of Salesmanship Training and Free Employment Service."

Into the Big Money Class

Berry did as the Salesman suggested. The answer he received from the N. S. T. A. absolutely astounded him. It was nothing short of a revelation—it was the most amazing PROOF of the short cut to big earnings that he had ever seen.

Warren Hartle, of 4425 N. Robey Street, Chicago, for example, had worked for ten years in the railway mail service at pay ranging from $900 to $1,600 a year. Then through the N.S.T.A. he became a Master of the Secrets of Selling that brought him $1,000 in thirty days.

George W. Kearns of Oklahoma City made $524 in two weeks. Before this he had never earned more than $60 a month. And C. W. Campbell of Greensburg, Pa., wrote, "My earnings for the past thirty days are $1,526 and I won second prize in March although I worked only two weeks during that month."

These are only a few of the cases of amazing jumps to big earnings. Berry was absolutely convinced and decided to accept the liberal offer of the N. S. T. A. to fit him for a position as a Master Salesman. In his spare time at home he learned the fundamental rules and principles of Salesmanship covering every branch of this fascinating field. Almost before he realized it he was ready to accept a position as Salesman with a big company to which the N. S. T. A. recommended him. The very first month he earned $1,000. One month his earnings ran as high as $2,140.

Other Amazing Jumps to Big Earnings

"Last week my earnings amounted to $534.32; this week will go over $400."—F. Wynn, 4103 Forty-Second St., Portland, Ore.

"My earnings during the past thirty days were more than $1,000."—Warren Hartle, 4425 N. Roby St., Chicago, Ill.

"After six months of success in a position secured through you I am earning $92 a week."—P. W. Brasdel, 736 Benedict Ave., Woodhaven, N. Y.

"I had never earned more than $60 a month. Last week I cleared $306 and this week $218."—Geo. W. Kearns, 107 Park Pl. Oklahoma City.

Startling Proof Sent Free

The same opportunity that brought Berry his amazing, quick success is now open to every reader of this magazine. You have only to write to the N. S. T. A. You will receive, without any cost or obligation, the remarkable Book on Salesmanship and startling Proof that you can quickly become a Master Salesman in your spare time at home. You will read the stories of hundreds of men who today are earning more money than they ever thought possible. What these men have done you too can do.

Surely you owe it to yourself to at least examine the evidence. It was worth $1,000 a month to Charles Berry to write to the N. S. T. A. It may be worth that much or more to you. Just mail the coupon. There is no cost or obligation. Address

National Salesmen's Training Association

Dept. 15-W **Chicago, Ill.**

National Salesman's Training Association
Dept. 15-W., Chicago, Ill.

Please send me your Free Salesmanship Book and Free Proof you can make me a Master Salesman. Also tell me how the Free Employment Service of the N. S. T. A. will help me to a Selling position and send list of business lines with openings for Salesmen.

Name.....

Address.....

City..... State.....

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DETROIT

The Auto Center Is the Logical Place To

LEARN AUTO AND TRACTOR BUSINESS

Training for Head and Hand

The automobile business offers a certain future and exceptional opportunities to the ambitious man who wants to work intelligently to put himself ahead. Why not make your dream of success a reality? 9,500,000 automobiles, trucks and tractors in use in this country are but an indication of the immense opportunities in Service Work. Opportunities for properly trained men are unlimited. Competent men are in demand to take charge of garages.

Some of the Opportunities

A BETTER JOB: In repair shops everywhere incompetent men are working because no better can be had. A good man can get a job at a raise anywhere.

FARM MECHANIC: Modern farms must have engines, cars, trucks, tractors and trained men to run them and maintain them. Every farm needs a skilled mechanic.

ELECTRIC SERVICE: 75% of repair troubles are electrical. Not 10% of auto-mechanics are skilled in this branch. Mechanics who will take training in electrical work can double their earnings.

BUSINESS OF YOUR OWN: Start a garage, electric service station, tire repair shop, battery station, or welding shop. Or sell cars, trucks, tractors, farm lighting systems. Small capital needed, and men who know their business can get that. The opportunities are actually unlimited in every one of these lines.

M. S. A. S. Graduates Succeed

Practical training is the reason. The same opportunity is open to you when you are trained to take it, and you can be so trained in a few short weeks, by coming to the Michigan State Auto School, in Detroit the Auto Center.

Learn by Correct Methods Endorsed by Leaders of the Auto Industry

This school is recognized and endorsed by the automobile manufacturers and leading dealers,—the men who know how training should be given to make the most valuable men. They want men who have trained their heads as well as their hands,—the M. S. A. S. kind.

Not only were the M. S. A. S. courses outlined with the assistance of the leaders of the Auto industry, but manufacturers everywhere supply us with equipment and keep it up-to-date. They cooperate with us to the fullest extent, and employ our graduates.

What We Teach

Autos, trucks, tractors, stationary engines, farm lighting systems, tire repairing, welding and brazing, battery repairing, machine shop work. Actual practice on the best equipment, thorough and systematic instruction.

Study the pictures on this page and get our catalog showing over 100 views of M. S. A. S. training.

Money Back Guarantee

We guarantee to qualify you for a position as repair man, demonstrator, salesman, garage man, automobile dealer, tractor mechanic and operator, chauffeur or farm lighting expert, or refund your money.

Life membership with privilege of our service free at any time, is included with your enrollment here.

Learn by Factory Endorsed Methods

Packard Motor Car Co. says: "We have no hesitancy in recommending M. S. A. S. in every particular."

The International Harvester Co. says: "We will gladly cooperate with the M. S. A. S. through our 90 branches. Our free catalog contains many factory helps."

Thomas J. Doyle, Dodge Dealer, says: "I heartily appreciate the great work you are doing for the industry by turning out trained men who can intelligently handle the difficult phases of motor car service."

Cadillac Motor Car Co., Detroit, says: "We believe you have the best and most complete school in the country."

Send for 188 Page Catalog

This book tells in detail of the openings awaiting you in this great business, about M. S. A. S. training, methods and equipment. It includes letters from graduates in all parts of the world, telling what this training has enabled them to do, and dozens of letters from leaders in the auto and tractor industry endorsing our methods. There is no obligation in sending for this catalog. It will tell you more about the opportunities for trained men in the great automobile business and what the M. S. A. S. can do for you.

We will gladly reply to personal letters and answer questions fully. Write today.

RADIATORS

BATTERIES

TRACTORS

MACHINE SHOP

ENGINES

FARM LIGHTING

ELECTRIC SERVICE

ELECTRIC SERVICE

IGNITION

GARAGE

WELDING

TIRES

MICHIGAN STATE AUTOMOBILE SCHOOL

A. G. ZELLER, PRES. & GEN. MGR.

ENDORSED BY THE LEADING AUTOMOTIVE MANUFACTURERS

592 AUTO BLDG., 3729 WOODWARD AVE., DETROIT, MICHIGAN, U.S.A.

SEND THIS COUPON NOW

MICHIGAN STATE AUTO SCHOOL,
592 Auto Bldg., 3729 Woodward Ave., Detroit, Mich.
Gentlemen: Please send me catalog FREE. Now I'm once interested in the
(Mark with cross you are interested in.)
☐ Auto and Tractor Course ☐ Battery Service
☐ Tire Repairing ☐ Machine Shop ☐ Welding
and Brazing
Name .....
Street .....
City .....
State .....

See the New Ideas for Men Who Work at Home with Tools, Classified in the Home Workshop Index on Page 2

Popular Science Monthly

TABLE OF CONTENTS

December, 1921 Vol. 99: No. 6

Special Features

How to Make an Aerosled at Home ..... Page 90

Harding's Portrait Sent by Wireless 21
Explorers Search for Waste Places 24
The Next War—Its Effect on Nations 26
How Four Boys Made Fame and Fortune in Wireless 29
Every-Day Wonders—Facts You Should Know 32
First Suspension Bridge Since 1909 46
Making Steel Direct from Ore 48
Airplane to Carry Twelve-Inch Gun 61

And 164 Other Interesting Items

AERONAUTICS

First Transatlantic Wireless News-Picture 21
The ZR3's Hangar 39
Keeps Airplane Engine from Freezing 44
Farmer's Airplane Rises from Dooryard 47
Dirigible Directs Land Traffic 56
Battleplane to Carry 12-Inch Gun 61

FOR THE FARMER

Raising Flax Instead of Thistles 33
Milk Aerator and Cooler 40
Testing the Breath of Bananas 40
Importing City Lighting for the Country 41
Grading Wheat in Garland Lots 44
Rain-Making Machine to Produce Storm 51
Ventilated Apartments for Birds 56
Wind Creates Natural Draft for Incinerator 57
Some By-Products of Cocoanuts 63
Seed Potatoes Cut by Machine 65
Homemade Sterilizer for Dairyman 68
Shoes for the Engine Bug Tractor 72
Build a Homemade Water-Pump 82
Let Your Ford Help in Farm Work 83

HOUSEKEEPING MADE EASY

Holds Lamp Globes Safely 38
Electric Iron Forms Stove 50
Open Fires Without Smoke or Dirt 54
Baby's Bath and the Latest Improvements 57
Electricity Heats Water Running Faucet 67

INDUSTRIAL PROGRESS

Machine Then Parcels the Grain Binder 32
Last Explorers Seeking Wealth for Mankind 34
Railroads Use Buses to Improve Service 38
Your Chances for Success in Radio 39
Conveyor Handles 100 Tons an Hour 41
Bones Fall 30 Feet Unhurt 43
Print 1500 Photographs an Hour 47
For Cutting Brass Rods 49
Portable Lamp Guard 49
Endless Elevator Loads Truck Quickly 50
Machine Measures Leather Arm 51
Horizontal Forge Press Economizes Space 52
Oil Tank Was Moved Nine Miles 53
Hydrochloric Acid Removes Boiler Scale 53
Suspension Bridge at Kingston 46
Million Tons of Coal from River Beds 47
Making Steel Direct from Ore 48
Earth-Borer Plants Dynamite 51
Extracting Oil from Apricot Kernels 51
Diver Can Now Light Torch Under Water 52
Good Lumber from Dead Trees 52
Rapid Interest Indicator for Banks 54
Contractor's Truck Carries Double Hoppers 54
Hand-Power Drill for Prospectors 55
Fast-Grinding Compound for Bearings 56
Separates Liquids from Soil 57
Centrifugal Force 58
It Measures Wire of Any Size 60
Blasting Fuses Cut to Safe Measure 66
Handle-Bar and Package-Carrier 67
Machine Makes Fine Operations 67
Writing a Message by Phone 68
Building-Block Made on Continuous Molder 72

MISCELLANY

Civilization Must Abolish War 26
Every-Day Wonders 32
Hand-Loom Produces Big Cravat Output 35
The Canyons of Lower New York 35
Adding Perspective to Motion-Picture 36
Elevators that Run on a Curve 36
Polarized Light Reveals Original Picture 37
A Plate Glass Fairyland 37
Giant Outdoor Reflector for the Movies 38
No Telephone Headbands for Dispatchers 38
Bungalows Made from Steel Cars 38
Graphite Spring in Ceylon 40
Fire-Truck Supplies Water Service 41
Bombs Reduce Rioters to Tears 41
Inspecting High-Tension Telegraph Poles 41
A New Way to Bob the Hair 42
The Tower Bridge in Valve Fittings 42
Cocoa Candle Will Burn in 4321 45
Photometer Reads Contour of Head 46
Printing Our Own Postage Stamps 48
Music Now Comes on the Movie Film 50
Crandstand from Automobile Boxes 50
Enlarged Phonograph as Vocal Sign-Post 50
How Are Two Drums in One 50
Scenery Create Scenery for Movies 51
Portable Typewriter for the Blind 51
What Do You Want to Know? 53
Wooden Tone-Arm for Phonographs 54
A Country Estate on a Factory Roof 54
Rotary Photo-Print Trimmer 54
Primitive Canoe of Inflated Skins 55
Power House Starts When Light Goes On 56
House Starting in the Philippines 56
Movies Carry Their Own Power Plant 57
Street Stations for First Aid 57
Be Measured for New Set of False Teeth 58
Tropical Lineman's Hard Job 59
Submarine Mine-Sweeper Enters the Movies 59
Identifying Criminals by Their Feet 60
Another Scale Foot 61
Motion-Pictures without Darkening Theater 64
Cow-Punchers Use Modern Mess-Wagon 64
Safety-Pin for Milk Cans 64
Flashlight with 200-Foot Range 65
Mixing Heat Instantly 65
To Measure and Record Rainfall 66
Flood Lights Illuminate Skyscraper 66
Sandy Dune Goes to Cultivating 66
Sword-Swallowing Made Possible 67
Clock Whittled from Bamboo 67
Pockets in Her Hat 67
Combination Chair and Umbrella for Artists 67
Spectroscope Detects Bloodstains 68
Government Preserves Indian Folk-Songs 69
Delivering Beer with a Hose 69
Gas-Propelled Trolley 69
No Contest for This White House 69
Moving Roadway for Japan 69
Film Projector and Screen in Same Cabinet 70
Sailing Deck for Crippled Children 70
Renews Blotting Surface 71
Curtiss Has World's Largest Bass Drum 71
This Extinguisher Uses no Liquid 71
Curtain of Water Safeguards Books 71
Disk Improves Phonograph Tone 72
Plowing with a Street-Car 72
Try These Speed Indicators 74
Keep Your Home Shipshape 83

MOTOR VEHICLES AND ACCESSORIES

How Hoodless Tires Are Made 34
Welded Keys in Transmission Shafts 35
Auto Crane for Barge Canals 36
The Tire Is Inside the Rim 44
A Homemade Silencer for the Motorcycle 50
An Improved Storage Battery 76
A Jeweler's Idea of Car Building 76
Vacuum Cleaner for Automobile 76
Steam-Car Has Engines on Rear Wheels 77
Fan-Belt Drives Tire-Pump 77
Safety Signal on Fender 77
Keep Grease off the Axles 77
Why You Should Buy a New Car 80
Shop Tire-Rack 81
Auxiliary Wind-Shield 83
Adjusted Radius Rods Prevent Skidding 82
For Spreading Automobile Springs 82
Special Tool for Wing-Nuts and Screws 82

NATURAL SCIENCE

Earth to Plow Through Comet's Wreckage 23
A Weed of a Thousand Punctures 39
World's Smallest Ornamental Tree 41
Mutilating Plants to Make Them Grow 48
Every Pebble a Hemisphere of Life 55
Animal Life in the Sky 57
Fossil Shark Could Swallow Small Whale 60
Dark Stranger Answers in Space 69

PICTORIAL PAGES

Railways of Odd Design 33
Japan's Silk-Making Methods 45
The Natural Perfume Industry of France 49
Tools and Machines that Are Money-Savers 62
The Story of Radium 70
How to Get the Most from Your Bid 75
For Comfort and Convenience 75
Automobile Accessories 78

RAILWAYS

Completely Automatic Car-Coupler 42
Locomotive Coal Pusher Saves Labor 51
Trailer-Car Gives Local Service from Trains 52
Railway Cars Unload Automatically 64
Giving the Engineer His Orders 65

SHIPS AND SHIPBUILDING

Davits Lower Lifeboats Quickly 52
Million Dollars Lost if This Lamp Goes Out 55
Bulges as Protection from Torpedoes 55
Mississippi's Shallow Draft Towboat 69
Pontoons to Replace Ferries 71

SPORTS AND PASTIMES

Made to Order Collisions for Amusement 34
Steel Ukuleles withstand Hard Usage 38
Bumps Help Drive This Bicycle 38
Roller Coaster Built by Children 44
Remote Control of Clay Pigeon Traps 63
Can You Get These Eye-Testers? 65
Bicycle Steers from the Rear 73

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SLICKER Oil, saves 25 to 50% gasoline. Cleans carbon from engine. Harmless. Fully guaranteed, money refunded if failing. Sample to treat 125 gallons gasoline, $1.00 C. O. D. Slicker Oil Co., Gateway Station, Kansas City, Missouri.

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PISTON Ring perfection reached, send for free evidence booklets, "It's What the User Says that Counts," that's making the demand for Reinicker Ever Tyte the ring that saves fuel and oil and increases efficiency, stops oil pumping, and saves reboring of cylinders. Made in all sizes up to 100 inches for boats, locomotives, engines, pumps, compressors, airplanes, etc. Will send on trial to anyone commercially rated. Ever Tyte Piston Ring Inc. St. Louis.

FORD ACCESSORIES

WIZARD battery charger for Ford cars, charges 6-volt battery from Ford magneto. Attaches to Ford in few minutes. Guaranteed to work perfect. Hundreds in use. No more oil lamps, electrify your Ford. Price $4.95, postage prepaid. Send money order. Agents wanted. Write for circular. Wizard Mfg. Company, 208 Jefferson St., Portland, Oregon.

GASIFIER saves gasoline, helps starting, prevents carbon; applied ten minutes, no changes. Special price Fords $1. Detroit Gasifier Co., 743 Book Building, Detroit.

SPEEDSTER Parts. See "Red-i-Kut" ad. page 135.

ELECTRICAL

BURGLAR ALARMS: Complete electric systems ready to install. Write for circular. W. S. Kuhn, 1308 Lafayette, St. Louis, Missouri.

WANTED

MANUFACTURER of wire specialties and stampings wishes to add additional articles to their line. Have you a product or a patent? Address Atlas Manufacturing Co., New Haven, Connecticut.

SPOT Cash for gold and valuables; returned if dissatisfied. Assaying for prospectors by graduate metallurgists. Central Refiners, 503 N. Prospect, Champaign, Illinois.

WANTED—Representatives in every Factory in the United States. Popular Science Monthly, 225 West 39th Street, New York.

UNUSUAL opportunity to earn large commissions in your town. Zeinicker, 1050 Kingsland Ave., St. Louis.

DUPLICATING DEVICES

"MODERN" Duplicators. Business Getters. $2.25 up. 50 copies from pen, pencil, typewriter. No glue or gelatine. 40,000 in use. Free trial. Need one? Booklet free. J. V. Durkin-Reeves Co., Pittsburgh, Pennsylvania.

FORMULAS

FREE—Formula Catalog. Laboratories, Boylston Building, Chicago.

FIVE formulas, $1.00! Silver Polish Starch Enamel, Formula for Gray Hair, Superior Baking Powder, Sewing Machine Oil, Toothache Drops. Albert Wilkinson, 51 Erie Avenue, Brantford, Ontario, Canada.

BEST SHINE Auto, Furniture, Polish. Formula $1.00 Bill. Collins, 4018 Ross, Dallas, Texas.

3000 FORMULAS—400 pages, $1.00. Catalogue free. Englewood Book Shop, 7021 D. So. Winchester, Chicago.

MR. ADVERTISER: Ask to-day for a copy of the "Quick-Action Advertising Rate Folder." It contains some really important facts which will prove interesting and valuable to you. It also tells "How You Can Use Popular Science Monthly Profitably." You'd like to know, wouldn't you? Manager Classified Advertising, Popular Science Monthly, 225 West 39th Street, New York.

MANUFACTURING

LET us be your factory! Write to-day. Lucas Machine Company, 722 South Clinton Street, Chicago, Illinois.

WE manufacture anything, develop and build special machinery. Get our booklet, it's valuable to you. E. G. Clyne Engineering Co., St. Louis, Missouri.

LABORATORY AND CHEMICAL SERVICE

CHEMICALS, glassware—complete supplies for the chemical laboratory. Catalogue 5 cents. National Scientific Supply Co., 941 Pennsylvania Avenue, Washington, D. C.

CHEMIST will test raw and finished products, formulas; solve industrial problems, and give testimony. J. Gash, Lexington, Kentucky.

YOUR chemical or electrical problem solved for Five Dollars. Write me. W. Stedman Richards, Consulting Chemist, 220 Washington St., Boston, Massachusetts.

Read This One!

Popular Science Monthly,
New York City.

Gentlemen:

As you know, I have been running an advertisement in Popular Science Monthly for nearly nine years, only missing when I was "doing my bit," and I must say that the amount invested is small considering the wonderful ORDERS—not merely replies—I have been getting.

I also notice that my key shows MORE REPLIES on "stationery" from your publication than any others, proving that the better type of business man reads the Classified Section.

You can count on my ad "t. f."

Very truly yours,
IRVIN DANIEL WOLF,
Printing.

This letter is but one of many which come in—VOLUNTARILY—from satisfied and successful advertisers. If YOU are interested in direct, profitable and continuous results at low cost, why not come along with us in the next issue? For further information as to rates, closing date, circulation, etc., address:

Classified Advertising Manager,
Popular Science Monthly,
225 West 39th Street,
New York City.

MAILING LISTS

MARRIAGES $5.00 per thousand. Other lists. Miller, Box 41, Berwick, Pennsylvania.

AMERICAN MADE TOYS

MANUFACTURERS wanted for large production and homeworkers on smaller scale for Metal Toys and Novelties. Toy Soldiers, Cannons, Cowboys, Indians, Buffalo Bills, Wild Animals, Whistles, Bird-Whistles, Race Horses, Prize-Fighters, Wagtail Pups, Put and Take Tops and hundreds of other articles. Hundreds and thousands made complete per hour. No experience or other tools needed. Casting forms, complete outfit from $5.00 up. We buy these goods all year, paying fixed prices. Contract orders placed with manufacturers. Exceptional high prices paid for painted goods. An enormous business for this year offers industrious men an excellent opportunity to enter this field. Write us only if you mean real business. Catalog and information free. Metal Toy Manufacturing Co., 1696 Boston Road, New York.

MOTORS, ENGINES, MACHINERY

ELECTRIC Motors, 50 heavy duty ¼ H. P. motors, General Electric and other standard makes. 110 volt, 60 cycle, single phase. Brand new, never unpacked. Guaranteed perfect. $18.00 and $20.00. Pennsylvania Motor Exchange, Lancaster, Pennsylvania.

SMALL Motors and Generators ¼ H. P., $18.50; ½ H. P., $28.50; 1 H. P., $46.50. 6 V. charging generators, $10.50 each. All sizes both motors and generators up to 5 H. P. in stock at all times. Bargain prices. Motor Sales Dept. 14, West End, Pittsburgh, Pennsylvania.

GUARANTEED Motors, Polyphase, 3HP $74. Easy payments. Other sizes also. Write us. Box 3, Hobarts, Troy, Ohio.

AVIATION

HEATH propellers represent the most efficient method of aerial drive. Each propeller individually designed for the particular work to be done, as laid out by America's oldest Aeronautical Engineer. Propeller catalog 4c. Heath Airplane Co., Chicago.

PROPELLERS for air propulsion. 5 ft. diameter $12. Other sizes in proportion. Hub mountings, bearings, sprockets and countershafts complete. Full scale blue prints for motorcycle-driven snow and ice sleds, 75c. Ford type, $1. Crawford Motor and Aeroplane Mfr., 148 South Rampart Street, New Orleans, Louisiana.

FOR November we offer the greatest bargains in the history of aviation. Dope $1.70, turnbuckles all sizes 25c, aero cloth 35c yard, tachometers $11, shock absorber 10c ft., Curtiss motors $275, Gnome motors $175, new propellers $15, clevis pins 3c, wheel covers $1.25, steel tubing 5c. Many wonderful bargains in November sale sheet. Heath Airplane Co., Chicago.

INVENTORS desiring information write for our Free Illustrated Guide Book and Evidence of Conception Blank. Send model or sketch of invention for our opinion of its patentable nature. Highest references. Prompt service. Reasonable terms. Victor J. Evans & Company, 151 Ninth, Washington, D. C.

BOYS build a three foot model aeroplane. Write for circular. Full size drawing. Aero Shop, 3050 Hurlbut Ave., Detroit, Michigan.

LEARN to fly with America's oldest aircraft company. Six hours flying worked in with three months' shop training at $100.00, makes our course the most complete ever offered, and an opportunity long waited for. Enroll at once. Heath Airplane Co., Chicago.

MODEL AND MODEL SUPPLIES

WE make working models for inventors and do experimental work, and carry a complete stock of brass gears and model supplies. Send for catalogue. The Pierce Model Works, Tinley Park, Illinois.

GET our booklet before placing order for models or anything you need. Our work the best, our prices right, our dealings square. E. G. Clyne Engineering Co., St. Louis, Missouri.

MODELS and Experimental Work of every description. Lamson Model and Experimental Works, 523 West Jackson Boulevard, Chicago.

MODEL aeroplanes that fly. Buy your complete outfit, scale drawings, fittings, compressed air motors and all best model aeroplane supplies from the Wading River Manufacturing Company. Established 1909. Our new fifty-two page catalog illustrates twenty-four latest models and designs. Send 10c for your copy. Wading River Manufacturing Company, 672B Broadway, Brooklyn, New York.

FOR THE HOME

GRANDFATHER clock works, $5.00. Build your own case, instructions free; make good profits selling your friends. Clock works with chimes for old or new cases. Write for full particulars. Clock Co., Nicetown, Pennsylvania.

FIREARMS

MAUSER .25 cal. automatic pistols, $11.75; .32 cal. $12.75; f. o. b. New York; factory new; no C. O. D. Sam Sloan, 88-C Chambers Street, New York.

MR. ADVERTISER: Ask to-day for a copy of the "Quick-Action Advertising Rate Folder." It contains some really important facts which will prove interesting and valuable to you. It also tells "How You Can Use Popular Science Monthly Profitably." You'd like to know, wouldn't you? Manager Classified Advertising, Popular Science Monthly, 225 West 39th Street, New York.

EFFICIENCY CHARTS

EFFICIENCY CHART. One side instantaneous stock ordering chart; other side, spark method of testing steel. Price, One Dollar, cash. A. E. Wrigley, 235 90th Street, Brooklyn, New York.

LETTER SPECIALISTS

FRANCIS writes the Best Sales Letters in the World. Floyd Delos Francis, Box 904, Atlantic City, New Jersey.

LETTERS applying for a position of any nature expertly written. $1.00. Floyd V. Studer, Canadian, Texas.

SALES Letters. Multigraphing. Circular Mailing. Miller, Box 41, Berwick, Pennsylvania.

Quick-Action Advertisements continued on page 8

Copyrighted material

My New Way in Selling

How I Learned the One Great Secret of Salesmanship in Twelve Hours

"YOUNG man, my advice is, to get into the selling end of the game!"

"But——"

"No buts about it, if you want to go ahead—*sell*. It is salesmen we want today—Salesmen. If you can sell things you will never have to worry about securing a position, or demanding a good salary."

"But, Mr. Cranshaw, I have had no experience — know nothing about it, why—"

"Then learn, sir—you've asked my advice and help, and there it is."

Deeply puzzled, I left his office. Like so many other young fellows looking for their first job, I had no very definite aim. I didn't mind hard work or small pay, as long as I felt that the future held some opportunity. I had called upon my father's old friend, Mr. Cranshaw, to help me decide what calling he thought promised the most. The above conversation was the result.

Mr. Cranshaw is an experienced business man and I respected his opinions. With his aid I found a job—and a fairly good one as jobs go—with a large farm-machine manufacturing company.

As soon as I learned something about my product I went out on the road. The optimism of youth was with me. I had a tremendous amount of self-confidence. My product was a good one.

But I ran into a snag when I came in contact with the hard-headed men who till the soil.

They were of all types, keen, and shrewd progressive men, who wanted to see an actual gain—return for every penny spent; old-fashioned men who didn't take to new-fangled methods; big business men who ran immense farms as a side issue. Every one presented a knotty problem. It seemed to me in my early days, that each man had to be "sold" in a different way. I kept a separate "method of attack" for each individual.

But, I was not a success. I made few sales. Every now and then, I put over a fairly big order, but I was not a consistent seller. The firm was not satisfied and they said so. I was costing them more than my work was bringing in. In a very frank talk one morning, they told me that if something didn't happen at once, I would be called in from the road.

Well, needless to say, I was discouraged. I thought things over. The success of my brother salesmen and competitors puzzled me. I observed them closely and tried to learn what it was that brought them their big sales. I noticed, to my surprise, that the men whose totals were the largest were the ones who seemed to work the least. But I could find no one trick that any of them possessed which I had not tried.

One day I met a hardware salesman in the smoking room of a train. We talked about the usual things for a while then we branched into selling methods. In the course of his conversation he told me how,

"In the last nine weeks my sales have topped the list."

after many years of mediocre success, he finally learned the one great secret of selling and what that secret is. It was simple as A. B. C.

It almost bowled me over. The simplicity and practicality of this great basic rule of success dazzled me. My guardian-angel must have been watching over when I met that salesman.

With impatient eagerness I started to put into practice my new-found knowledge. The startling suddenness of the results was almost uncanny. After my next turn on the road the senior member of the firm personally congratulated me. My sales on that one trip were larger than the total of my three previous efforts. In four short months I became the best salesman on the firm's roster. I was leading even the oldtimers. And from that time to this I have never once relinquished the lead.

Mr. Cranshaw's promise had come true—"Get into the selling game, if you want to go ahead," he had said—and I had.

But before I had found the all-comprising fundamental secret of salesmanship, I had been as near a failure as a man can be. The rapidity of my sensational rise seems almost unbelievable—even to myself.

Don't misunderstand me, I am not trying to pat myself on the back. I am not an unusual man in any way and do not claim to be. What I am driving at is this: If I, a young fellow who almost missed my chance, could, in the short space of four months, become a top-notch salesman, merely by the mastery of *this one principle,—others can do the same.* And I must add my opinion to Mr. Cranshaw's, the selling game *does* hold the greatest promise of all for the future success.

This thing which so quickly placed me in my present highly-paid position of master-salesman was a knowledge of the One Great Secret in Selling, and its 100 Devices as told in *Arthur Newcomb's* astonishing 7-lessons course in Super-Salesmanship. This course, I firmly believe is the nearest existing thing to a Royal Road to Success in Selling.

It is not, like so many other salesmanship courses, a theoretical treatise. It is old-fashioned common-sense brass-tacks. Like all other sciences, selling has for its foundation a certain bed-rock law. Ignorance of this is the reason so many salesmen fail.

Mr. Newcomb takes this law, shows it to you, explains it, and then shows you how to use it. It is your weapon. And it is worth more than all the tricks and stunts, and theories of selling put together.

Mr. Newcomb does not teach or preach. From his years of experience as salesman, sales-manager and student of selling-science he had condensed into this remarkable book, the one great selling secret—and its one hundred simple devices which all successful salesmen must have. He gives you this secret—that is all there is to it. No matter what you are selling the rule applies. Mr. Newcomb says, "This is the way to do it. Now go ahead." And it works. It always has worked. It has been tested and approved by every man who ever sold anything. Consciously or unconsciously *every sale that has ever been made, was made by the application of this one tremendous truth.*

But do not take anybody's word for it. You can be the judge yourself. It will not cost you one penny. Don't send any money. Merely mail the coupon or write a letter, and the complete course will be sent, all charges prepaid, at once, so that you may take advantage of the special price and save $2. If you are not entirely satisfied, send it back any time within five days after you receive it and you will owe nothing.

On the other hand, if you are as pleased as are the thousands of other men and women who have used the course, send only $3 in full payment. You take no risk and you have everything to gain, so mail the coupon now before this remarkable offer is withdrawn. Independent Corporation, Dept. S-7712, 319 Sixth Avenue, New York City.

400,000

people have paid $5 or $7 for one of our Self-Improvement Courses—and remember no one was asked to pay until he had five days to examine the course in his own home.

Until the Independent Corporation published the "Rath Memory Course," "Pitman Shorthand," "Mastery of Speech," "Drawing, Art and Cartooning," "Reading Character at Sight," "How to Write Stories," "Super-Salesmanship," and other personal development courses, where could anyone buy similar courses for less than $15 to $75?

Because we want to add two hundred thousand more names to our list of satisfied customers at an early date, we are making a

SPECIAL PRICE, $3

(Regular Price $5)

Others sell from $15 to $75

Act quickly as this special opportunity may be open for only a short time. Many purchasers have written letters similar to Robert P. Downs, of Detroit, Mich., who recently wrote:

"I can't see how you ask so little, while others with far inferior courses get from $20 to $60 for theirs."

(FREE EXAMINATION COUPON)

Independent Corporation

Dept. S-7712, 319 Sixth Avenue, New York

Gentlemen:—Please mail me the Course "Super-Salesmanship" for 5 days' free trial. If I decide to keep it I will remit $3, the Special Price. Otherwise I will return it to you. It is understood that this coupon puts me under no obligation whatsoever.

Name.....

Address.....

.....Pop. Sc. 12-21

He Was a

Machinist

Now He is a

Mechanical Engineer

He Used to Make $26 a Week He Now Gets

$7,500 a Year

John Guest worked in a machine shop with a score or so of others. He could read and write and do simple arithmetic—that was all. Several of the others had received considerably more schooling than he.

His advancement began when he took up a course in Mechanical Drafting in his spare time. Once he had learned drafting, he forged straight ahead. He was made foreman for the company, then superintendent, then, because by this time spare time study had qualified him for the place, he became mechanical engineer for a great manufacturing concern.

Most of "the others" are still in the shop, or in other similar shops, or looking for jobs in shops. Those who have work earn a little more now, it is true, but their dollars buy far less. Every one had the same chance as John, but—

You have the same chance, too. The I. C. U. Mechanical Drafting Course is YOUR opportunity to qualify for a position like John's. In your own home, in your spare time, without losing an hour from your work, you can make yourself a practical Mechanical Draftsman.

Back of the I. C. U. courses stands T. J. Foster, founder of correspondence instruction, the first man in the world to demonstrate that Mechanical Drawing could be taught successfully by mail. Associated with Mr. Foster as Dean of the Faculty of the I. C. U., is Harry S. Bitting, President of the Williamson Trade School, the acknowledged leader among American vocational schools.

I. C. U. courses are sold on the

Pay as You Study

plan. The student is greatly advantaged because, whether he enrolls for cash or on the installment plan, he pays for only a part of his course at a time as he proceeds with his studies.

Take the first step toward a position and salary like John Guest's. Use the coupon. No obligation.

Industrial Correspondence University, Inc.,
Dept. C, 1504 Locust St., Philadelphia, Pa.

Please send me full information about the course before which I have marked X and about your "Pay as You Study" plan. In asking for information, I assume no obligation.

- Mechanical Drafting
- Architectural Drafting
- Complete Blue-Print Reading
- Blue-Print Reading for Machinists and Metal Artisans
- Blue-Print Reading for Carpenters and Building Tradesmen
- Blue-Print Reading for Structural Ironworkers
- Blue-Print Reading Pattern Makers and Cabinet Makers
- Blue-Print Reading for Blacksmiths
- Foreman's Course
- Course in Employment Management and Personnel Activities

Name..

Street & No..

City or Town.......................... State..........

Occupation.......................... Age..........

Quick-Action Advertisements continued from page 6

FOR BOYS

PLAY Mouth-organ. Complete, easy instructor, 25c. Elms, Publisher, Bowling Green, Ohio.

STAMPING NAMES

MAKE $19.00 Hundred Stamping Names on Key checks. Send 25c for sample and instruction. PS Keytag Company, Cohoes, New York.

CIGARS, CIGARETTES, TOBACCOS

BUY your cigars direct. "Fifty La Columnas Prepaid $1.75. Agents wanted. Havana Smokehouse, Homeland, Georgia.

MR. ADVERTISER: Ask to-day for a copy of the "Quick-Action Advertising Rate Folder." It contains some really important facts which will prove interesting and valuable to you. It also tells "How You Can Use Popular Science Monthly Profitably." You'd like to know, wouldn't you? Manager Classified Advertising, Popular Science Monthly, 225 West 39th Street, New York.

MISCELLANEOUS

HOW to Build Beautiful Homes at Small Cost. Read my book on the Twentieth Century Building Materials. Price One Dollar. Circulars free. Peter de Lande, Ione, Illinois.

FOR your lawn use hardwood ashes. Sixteen dollars ton. George Stevens, Peterborough, Ontario.

MFRS. lead soldiers: save time. Painting made easy. Make device yourself. Instructions postpaid, $1.00. Lock Box 146, Aurora, Illinois.

LUMINOUS Paint, Bottle 50c, Laboratories J, Box 516, Portland, Oregon.

TELEGRAPHY

TELEGRAPHY (both Morse and Wireless) and Railway Accounting taught quickly. Big salaries. Great opportunities. Oldest and largest school; established 46 years. All expenses low—can earn large part. Catalog free. Dodge's Institute, K Street, Valparaiso, Indiana.

STAMMERING

STAMMERERS—You can be permanently cured by my course of private individual lessons. Interesting booklet free. Samuel E. Robbins, 246 Huntington Avenue, Boston.

ST-TUT-T-T-TERING and Stammering cured at home. Instructive booklet free. Walter McDonnell, 80 Potomac Bank Building, Washington, D. C.

ADVERTISING

ONE Inch Advertisement in 100 country town newspapers, $12.00. Ad-Guide free. Commercia Magazine, 32W York, Pennsylvania.

$1.50 day makes classified advertising pay big. Get proposition. Climax Advertising Agency, Desk G, Clinton, Iowa.

FLYERS: 24 words in 250 weeklies, $15. Central Agency, Champaign, Illinois.

ADVERTISE in 24 Metropolitan Dailies, 25 words $15. Helpful Guide listing 1000 publications, 4c stamps. Wade, Baltimore Bldg., Chicago.

HAVE your letters, folders, booklets, written by original forceful writer who digs for business—That's me. Johnson, 2043 Rowe St., Chicago.

MR. ADVERTISER: Ask to-day for a copy of the "Quick-Action Advertising Rate Folder." It contains some really important facts which will prove interesting and valuable to you. It also tells "How You Can Use Popular Science Monthly Profitably." You'd like to know, wouldn't you? Manager Classified Advertising, Popular Science Monthly, 225 West 39th Street, New York.

TYPEWRITERS AND SUPPLIES

ALL makes, $15.00 up; fifteen days' free trial. Catalogue mailed on request. Henry Typewriter Company, 217 West 125th Street, New York City.

TYPEWRITERS—All makes. Factory rebuilt by "Famous Young Process." As good, look like, wear like, guaranteed like new. Our big business permits lowest cash prices. Machines rented or sold on time. Whatever your needs we can best serve you. Write now. Young Typewriter Co., Dept. 304, Chicago.

FOR SALE

U. S. and Foreign military medals, insignias and decorations of all kinds. Sam Sloan, 88-C Chambers St., New York.

PICTURES AND POSTCARDS

TEN exquisite Thanksgiving, Christmas, New Years, Birthday, Comic, or Asbury Park postcards, 10c., 75c per 100. Richard Lavery, Asbury Park, New Jersey.

PATENTS FOR SALE

WE have a few practical money making inventions for sale or trade. Adam Fisher Mfg. Co., 183B, St. Louis, Missouri.

SCENERY FOR HIRE

SETTINGS for Opera, Plays, Minstrels. Plush Drops. Catalog. Amelia Grain, Philadelphia.

MR. ADVERTISER: Ask to-day for a copy of the "Quick-Action Advertising Rate Folder." It contains some really important facts which will prove interesting and valuable to you. It also tells "How You Can Use Popular Science Monthly Profitably." You'd like to know, wouldn't you? Manager Classified Advertising, Popular Science Monthly, 225 West 39th Street, New York.

Quick-Action Advertisements continued on page 10

Electrician's Wiring Manual

Tools and Symbols—Preliminary Suggestions on Building Wiring—Moulding—Flexible Conduit—Rigid Conduit—Fixtures and Their Installation—Switches—General Suggestions on House Wiring—Installing Household Electrical Utensils—Wires and Cords—Motors—Transformers—Switchboards and Panels—Motion Picture Theater—Bell Circuits, Annunciator Circuits, Gas Lighters, Burglar Alarms, Bell Transformers, Door Lock—Elevators—Wiring in Damp Places—Outside Wiring—Grounding and Ground Detectors—Inspector's Report on a Defective Electrical Equipment—Estimating and Specifications—Tables and Formulas—Electrical Circuits, Calculation of Wiring, Line Losses and National Electrical Code Discussed for the Beginner—Alternating Currents Simply Explained—Some Things the Electrician Should Know About Storage Batteries—Underwriters' Requirements in the Installation of Wireless Telegraph Equipment—Practical Kinks.

There are many formulas and tables which are of great value to the electrician.

This is a book every wide-awake electrician or any one who wishes to do any wiring should own. Don't take chances, but be sure your work will pass the fire inspector. This Manual may save you 100 times the price of the book.

448 Pages, 414 Illustrations, Handsome Flexible binding. Pocket size. Price, postpaid, $2.50.

Experiments With 110-Volt Alternating Current

By J. D. ADAMS

Here at last is a book that develops a practical working familiarity with the alternating current—the form in which electricity is used in every home. The author shows how this can be done in an interesting and inexpensive way.

The only way to gain a thorough understanding of electricity as it is used commercially is by direct personal experiment. The knowledge thus gained is of vastly more value and importance than that acquired from the performance of the stereotyped series of battery experiments so uniformly described in the text-books.

256 pages, 125 illustrations. Price, postpaid, $1.75

Construction of Small Alternating Current Motors

By PROF. A. E. WATSON
Brown University

This book contains complete instructions for building small alternating current motors in several sizes. The designs will be found in harmony with those of the very best manufacturers and they can be worked out by the amateur for making useful instruments.

Some of the subjects taken up are "Characteristic Features of Alternating Current Motors," "Construction of a One-Half Horsepower, Single Phase Induction Motor," "Procedure in Testing and Using an Alternating Current Generator or Synchronous Motor." Clear, concise directions and careful drawings are features of this book.

Fully Illustrated. Price, $1.50

Popular Science Monthly
225 West 39th Street, New York

"We've got to hold Holloway!"

"HE came in to see me this morning and said the National people had offered him $5,000 a year. We've got to meet that offer! We've got to hold Holloway

"He's got just the training and the knowledge we need. We can't *afford* to lose him. He's the most valuable man in his department.

"It's wonderful what that fellow has done. Out of a $20 a week man, he's made himself a $60 man and it's taken only a year

"Since the time I had word from the International Correspondence Schools that Holloway was studying in his spare time he's gone forward by strides. I wish some of the other men would do the same thing. We need more men like Holloway"

EMPLOYERS everywhere are looking for men like Holloway—men who want to get ahead—who are willing to devote a part of their spare time to training for advancement.

Are you in this class? How much longer are *you* going to wait before taking the step that is bound to bring you a better job and more money?

For 30 years the I. C. S. has been helping men and women along the up-road to success in business and in life.

Would you like to be a first-class Mechanical, Electrical or Civil Engineer? A Chemist? An Architect? A Building Contractor? Hundreds of thousands of men have climbed into big jobs in the technical professions through I. C. S. help.

Do you want to advance in Business? In Advertising? In Salesmanship? Many of the country's foremost Advertising and Sales Managers have won success through I. C. S. training

Accounting? Commercial Law? All over America, bookkeepers, accountants, office managers, private secretaries, are reaping the rewards of time invested in I. C. S. training in these subjects.

It takes but a moment to mark the career of your choice, sign your name, clip out and mail the coupon printed on the right. Yet that simple act has started more than two million men and women toward success.

You have seen it in almost every magazine you have looked at for years. And while you have been passing it by, more than ten thousand men and women each month have been making it the first stepping stone to real success in life.

Will you still turn away from Opportunity? Can you still go on, putting in your days at the same grind, getting the same pay envelope with the same insufficient sum, when such a little thing can be the means of changing your whole life?

You *can* have the position you want in the work you like best, a salary that will give you and your family the home, the comforts, the little luxuries you would like them to have. No matter what your age, your occupation, your education, or your means—you can do it

All we ask is the chance to prove it. That's fair, isn't it? Then mark and mail this coupon. There's no obligation and not a penny of cost. It's a little thing that takes but a moment of your time, but it's the most important thing you can do to-day. Do it now!

TEAR OUT HERE

INTERNATIONAL CORRESPONDENCE SCHOOLS
Box X 7846-B SCRANTON, PA.

Without cost or obligation, please explain how I can qualify for the position or in the subject before which I have marked an X in the list below

☐ ELEC. ENGINEER	☐ BUSINESS MANAGEMENT
☐ Electric Lighting & Ops.	☐ SALESMANSHIP
☐ Electric Wiring	☐ ADVERTISING
☐ Telegraph Engineer	☐ Business Correspondence
☐ Telephone Work	☐ ILLUSTRATING
☐ MECHANICAL ENGR.	☐ Show Card & Sign Pntg.
☐ Mechanical Draftsman	☐ Cartooning
☐ Machine Shop Practice	☐ Private Secretary
☐ Toolmaker	☐ Business Correspondent
☐ Gas Engine Operating	☐ BOOKKEEPER
☐ CIVIL ENGINEER	☐ Stenographer & Typist
☐ Surveying and Mapping	☐ Cert. Pub. Accountant
☐ MINE FORM'N or ENGR.	☐ TRAFFIC MANAGER
☐ STATIONARY ENGR.	☐ Railway Accountant
☐ Marine Engineer	☐ Commercial Law
☐ ARCHITECT	☐ GOOD ENGLISH
☐ Contractor and Builder	☐ Common School Subjects
☐ Architectural Draftsman	☐ CIVIL SERVICE
☐ Concrete Builder	☐ AUTOMOBILES
☐ Structural Engineer	☐ Railway Mail Clerk
☐ PLUMBING & HEAT'G	☐ Mathematics
☐ Sheet Metal Worker	☐ Navigation
☐ Textile Overseer or Supt.	☐ Agriculture
☐ CHEMIST	☐ Poultry
☐ Pharmacy	☐ Banking
	☐ Spanish ☐ Teacher

Name _____

Street and No. _____

City _____ State _____

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MR. ADVERTISER. Ask to-day for a copy of the "Quick Action Advertising Rate Folder." It contains some really important facts which will prove interesting and valuable to you. It also tells "How You Can Use Popular Science Monthly Profitably." You'd like to know, wouldn't you? Manager Classified Advertising, Popular Science Monthly, 334 West 30th Street, New York.

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RESEARCH information furnished on any subject or money refunded, 50c. Confidential Service, Times Plaza Box 944, Brooklyn, New York.

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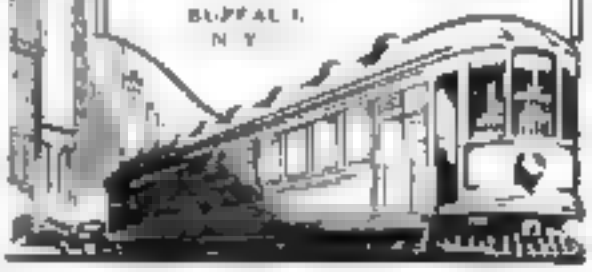

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Quick-Action Advertisements continued on page 11

FOR MEN AND WOMEN

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[illegible] Free Info. Relief and A Perfect Scientific Supplies Co. Thomas Mfg. Co., 4 Kennedy Bldg., Omaha, Nebr.

TATTOO Supplies. Learn the trade. Catalogue 10c. Prof. Wagner, 1141 Randolph, Detroit.

SEE ALSO [illegible] Ask today for a copy of the Quick Action Advertising Rate Folder. It contains some really important facts which will prove interesting and valuable to you. It also tells How You Can Use Popular Science Monthly Profitably. You'd like to know, wouldn't you? Manager Classified Advertising, Popular Science Monthly, 225 West 39th Street, New York.

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FILMS Developed 5c roll, prints 3c each. Photo Service, 820 McMillan, Cincinnati, Ohio.

MAIL us 20c with any size film for development and six velvet prints. Send all negatives any size and 20c for six prints. Enclose 20c for each 8 x 10 enlargement. Prompt, perfect service. Roanoke Photo Finishing Company, 1[illegible] Bell Avenue, Roanoke, Virginia.

[illegible] Write for free sample of our big magazine showing how to make better pictures and earn money. American Photography, 88 Exchange Street, Boston, 17, Massachusetts.

PICTURE-MAIL. Amateurs only, send us 25c with first roll. Pay a fair price and see the difference. Phillip Photo, [illegible], Columbus, Nebraska.

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A [illegible] Send roll to Little Film Newspaper and 25c for sample. [illegible] Handkerchief. ADELPHIA Photo Service, Bristol, Vermont.

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BUILD your Phonograph. Perfection, high quality spring and electric motors. Tone Arms, Reproducers, wonderful results. Big saving. New catalog and [illegible] Inserts hand mailed for 2c stamp. Chamber Stamping & Supply Co., Phonograph Supply Dept., 316 Hallwell Block, Indianapolis, Ind.

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[illegible] All kinds. Lists. Higgins, X2441 Post Street, San Francisco.

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SEE ALSO [illegible] Ask today for a copy of the Quick Action Advertising Rate Folder. It contains some really important facts which will prove interesting and valuable to you. It also tells How You Can Use Popular Science Monthly Profitably. You'd like to know, wouldn't you? Manager Classified Advertising, Popular Science Monthly, 225 West 39th Street, New York.

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Quick-Action Advertisements continued on page 12

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Automobile Painting	Cloth	1.50
Estimates, Costs and Profits, Painting and Decorating	Cloth	1.50
New Hardwood Finishing	Cloth	1.50
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Automobile Starting and Lighting by Manly	Leatherette	2.00
Brookes' Automobile Handbook	Leatherette	2.00
Ford Motor Car, Truck and Tractor, by Manly	Cloth	1.50
Starting and Lighting Troubles, Remedies and Repairs by Manly	Leatherette	2.00
Automobile Battery Care and Repair by Manly	Leatherette	2.00
Automobile Catechism and Repair Manual	Leatherette	1.50
Tires and Vulcanizing, by Tallant	Cloth	1.00
Gas and Oil Engine Handbook	Cloth	1.50
Automobile Upkeep and Care by Manly	Cloth	1.50
Motorcycle Handbook, by Manly	Cloth	1.50

Slide Rule and Logarithmic Tables	Leatherette	$2.00
Handbook for Millwrights	Cloth	2.00
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Better Business English	Leatherette	1.50
Better Advertising	Leatherette	1.50
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Spanish without a Teacher	Cloth	1.25
German without a Teacher	Cloth	1.25
Everyday French		1.25
Everyday Spanish		1.25
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Elementary Chemistry	Cloth	1.50
Complete Course in Civil Service, Cloth		1.50
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NEW YORK CITY
July 9th, 1921

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Yours for bigger things,
OSCAR MOFFITT

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Dept. 1312, 305 Broadway, N. Y. City

Dear Sir: I enclose herewith 10 cents, for which you are to send me, without any obligation on my part whatever, a copy of your latest book, "Muscular Development." (Please write or print plainly.)

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Address

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CORNETISTS, Saxophonists, Trombonists, Clarinetists. Send for Free Pointers on Weak lips. High Tones, Low Tones, Staccato, Jazzing. Mention instrument. Virtuoso School, Buffalo, New York.

WRITE the words for a song. We revise poems, write music and guarantee to secure publication. Submit poems on any subject. Broadway Studios, 121C Fitzgerald Building, New York.

WRITE a Song Poem—Love, Mother, Home, Comic or any subject. I compose music and guarantee publication. Send words to-day. Edward Trent, 621 Reaper Block, Chicago.

WRITE the words for a song. We will compose music, secure copyright and print. Submit poems on any subject. Seton Music Company, 920 S. Michigan Avenue, Room 1, Chicago, Illinois.

SONGWRITERS! Learn of the public's demand for songs suitable for dancing and the opportunities greatly changed conditions offer new writers, obtainable only in our "Songwriters Manual & Guide" sent free. Submit your ideas for songs at once for free criticism and advice. We revise poems, compose music, secure copyright and facilitate free publication or outright sale of songs. Knickerbocker Studios, 3:6 Gaiety Building, New York.

SONG WRITERS—Send for my free pamphlet, "Song Writers' Secrets." Ethwell Hanson, Room 607, 3810 Broadway, Chicago.

SONG-WRITER'S Booklet Free—A wonderful instructive booklet, "The Song-Writer's Guide," sent absolutely free. Submit your latest song-poems. We write music, print and secure copyright. The Metropolitan Studios, Room 921, 914 South Michigan Avenue, Chicago.

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MR. ADVERTISER: Ask to-day for a copy of the "Quick-Action Advertising Rate Folder." It contains some really important facts which will prove interesting and valuable to you. It also tells "How You Can Use Popular Science Monthly Profitably." You'd like to know, wouldn't you? Manager Classified Advertising, Popular Science Monthly, 225 West 39th Street, New York.

Quick-Action Advertisements continued on page 13

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PECAN and Orange Orchards on the Gulf. Easy terms. Big quick returns. Dept. C. Suburban Acres Company, Gulfport, Mississippi.

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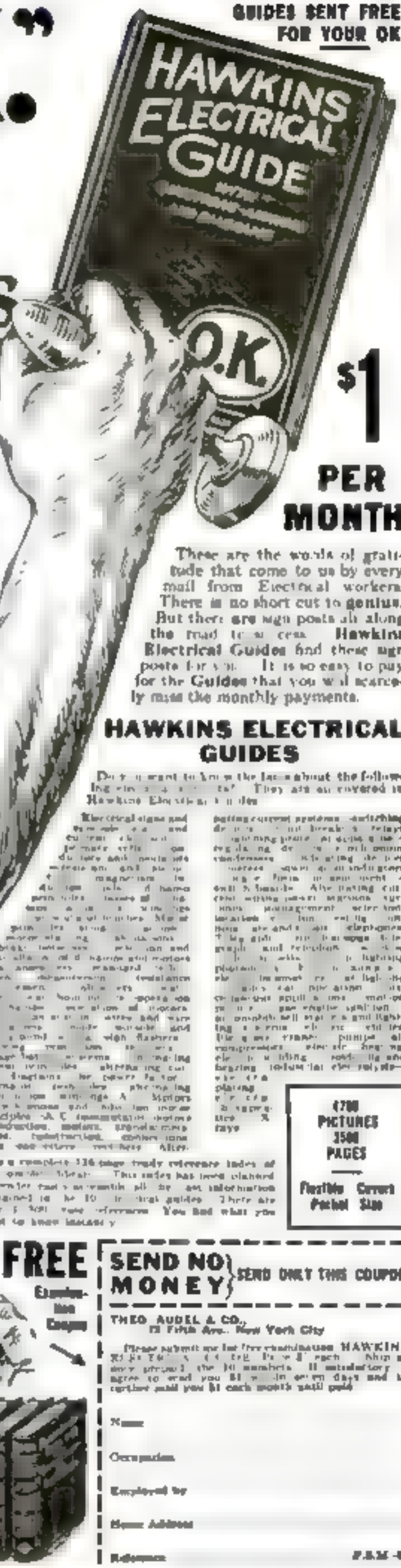

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Industrial Extension Institute
8 West 45th Street, New York City

Name

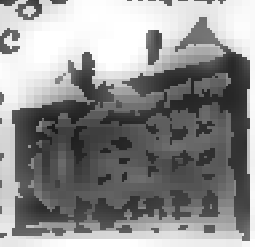
Address

(Pop. Sci. Mo., Dec. 1921)

National College of Chiropractic

Catalogue on Request

16 N. Ashland Blvd. Chicago



This Man Earns $83 a Day

His name is J. F. James. He left school when he was a boy. He was down, but he refused to stay down. He worked! He studied! And today he is president of the Mascot Stove Company of Chattanooga, Tenn., at a salary of $25,000 a year! He says that the I. C. S. "made his success possible."

Won't you let the I. C. S. help you, too? When everything has been made so easy—when so many other men are going forward to success—can you afford to let another priceless hour go to waste?

The way is easy. Without obligation or a penny of cost, mark and mail the coupon today and let us tell you how you, too, can win advancement and more money through spare-time study at home with the I. C. S.

— — — — — — TEAR OUT HERE — — — — — —

INTERNATIONAL CORRESPONDENCE SCHOOLS
Box ... Scranton, Pa.

Explain fully about your Course in the subject marked X

- DRAFTING
- Mechanical Engineering
- Surveying
- Civil Engineering
- ARCHITECTURE
- Electrical Engineering
- Machinery
- CHEMISTRY
- & PHARMACY
- STENOGRAPHY
- Advertising
- Salesmanship
- Bookkeeping
- Civil Service
- Mail Service

Name
Street
Address
City .... State ....

DISTRICT Managers wanted for tremendously successful new office specialty. Two minute demonstration means sale. Wonderful repeater. Gold mine for us. Perfection Mfg., 133 So. Fourth, Philadelphia, Pennsylvania.

SELL necessities. Everybody needs and buys the "Business Guide." Bryant cleared $500 in July. Send for sample. It's free. Nichols Company, Box 1H, Naperville, Illinois.

W... CHROME cloth polishes all metals. Sample and particulars free. Manufacturer, 404-E, Sun Building, Detroit, Michigan.

OFFICE Necessity. Costs 25c, sells $1.00. Big repeater. Agents coining money. Acidproof Ink Co., Philadelphia, Pennsylvania.

REALIZE your spare time easily and pleasantly. Make $... where you now make $... No experience nor capital necessary. Stacey, 4040 Crutcher Street, Dallas, Texas.

MR. ADVERTISER: Ask to-day for a copy of the "Quick-Action Advertising Rate Folder." It contains some really important facts which will prove interesting and valuable to you. It also tells "How You Can Use Popular Science Monthly Profitably." You'd like to know, wouldn't you? Manager Classified Advertising, Popular Science Monthly, 225 West 39th Street, New York.

TOWLINES. Small. Guaranteed. See advertisement under AUTOMOBILE ACCESSORIES. Superior Manufacturing Company.

AGENTS: A new invention. Harper's fibre broom and ten-use brush set. It sweeps, washes and dries upstairs windows, scrubs porch railings and does seven other things. Big profits, easy seller. Free trial offer. Harper Brush Works, Dept. G, Fairfield, Iowa.

MAKE 600% profit. Free samples. Lowest priced gold window letters for stores, offices. Anybody can do it. Large demand. Exclusive territory. Big future. Side line. Acme Letter Company, 2800 W. Congress, Chicago.

17 CENTS profit on every 25-cent sale means big daily profits. Box 600, Shreveport, La.

FREE Sample. "Rain Shield Wiper." Every Autoist buys quickly. Retails $1.00. Costs you 35 cents—150% Profit. No mechanical attachment, no cloth. One rub keeps windshield clear 24 hours against rain, snow, storm. Wonderful side line, carried in pocket. Only 1 free sample given away in your town. Hurry, write for yours. Nu-Life Auto ... Aid Corporation, Hartford, Connecticut.

CLEAN money selling Nonwetted Shoulder Strap Waterproof Aprons. Every woman buys. First on market. We manufacture and ship direct. Get details to-day. A. E. Berger Manufacturing Company, 413 Locust Street, Philadelphia.

AGENTS making money selling Universal Gas Savers for every gas stove. Wonderful device. Cuts gas bills in half. Increases heat. Popular prices. 100% Profit. Exclusive territory. Write quick. ... Moore, Gas Saver Company, Topeka, Kansas.

EVERYBODY eats every day. You can handle Sugar, Flour, Canned Goods, Dried Fruit, Coffee and entire line of groceries, as well as Paints, Roofing, Aluminum Ware and Automobile Oils with no rent to pay, no money invested. Take orders from samples. Goods are guaranteed and first quality. Selling experience not necessary. Steady, profitable work for workers. Address, Hitchcock Hill Co., Dept. 230, Chicago, Ill. Reference: Any Bank or Express Co.

AGENTS Wanted. Something New. Fire Fighter sells easily. Makes a spectacular demonstration. Car owners, homes, factories, stores, practically buy on sight. Our men make $10.00 to $50.00 a day. Exclusive territory. If you wish to establish a business of your own with unlimited possibilities for making big money, write us today. Fyr-Fyter Co., 109 Fyr-Fyter Bldg., Dayton, Ohio.

We want men and women who are desirous of making $25.00 to $200.00 per week clear profit from the start in a permanent business of their own. Mitchell's Magic Marvel Washing Compound washes clothes spotlessly clean in ten to fifteen minutes. One hundred other uses in every home. Nothing else like it. Nature's mightiest cleanser. Contains no lye, lime, acid or wax. Fastest selling article ever sold through grocers. Free samples make sales easy. Enormous repeat orders—300% profit. Exclusive territory. We guarantee sale of every package. No capital or experience required. Baker, Ohio, made $600 last month. You can do as well. Send for free sample and proof. L. Mitchell & Co., Desk 301, 1308-1314 E. 61st, Chicago, Illinois.

A Good Seller. A decent income. Precision Co., Queens, New York.

CALIFORNIA Buckskin Mending Tissue repairs clothing without thread. Recommended by housewives everywhere. Splendid side line. A lasting proposition and sample free. Nofhsah (?), East San Diego, California.

AGENTS easily earn money with newest, greatest household article ever put out. Every woman wants this article as soon as she sees it. Every home a prospect for one to a dozen. Saves food, saves time—saves money. Forty per cent commission on all sales. Be first in your territory. Make big money. Write now for full particulars. The Ardor Company, 500 E. Illinois Street, Chicago, Illinois.

HIGH class specialty salesmen traveling one or more States with spare time, will review to art salesmen. Big money with us. Credentials or no answers. Confidential. Ricker Co., 4107 Wentworth, Chicago.

MAKE Money at home making toys—we show you how. Send for the Manual for complete working drawings and instructions. Decatur Designing Co., Decatur, Georgia.

FREE Sample of quick selling patented specialty. Live Wire salesmen get yours now. Also details of wonderful $5,000 year opportunity. Agents wanted everywhere. H. C. Martin, 67 Cliff St., New York.

AGENTS: If you are making less than $300 a month, our proposition on Sentinel Burglar Alarms for windows and doors will interest you. Many agents earn $20 daily. Brand new invention. No wires or batteries. Instantly attached to any door or window. No competition. Provides cheap burglar insurance. Big money makers. Write to-day for extremely liberal terms to agents. Sentinel Alarm Co., 1452 Marquette Bldg., Chicago, Illinois.

SELL Food Products. Everybody has to eat. Strictly high grade pre-war prices. Steady work. Good profit. Sample Free. Consumers Supply Company, 601 Consumers Bldg., Portland, Michigan.

MILLER made $225 one week selling Guaranteed Business Producer. How to Display metal changeable letter sign for stores, worth $5, sells $3, sample $1.50 postpaid. Write Carrier Mfg. Co., Minneapolis, Minnesota.

MR. ADVERTISER. Ask to-day for a copy of the "Quick-Action Advertising Rate Folder." It contains some really important facts which will prove interesting and valuable to you. It also tells "How You Can Use Popular Science Monthly Profitably." You'd like to know, wouldn't you? Manager Classified Advertising, Popular Science Monthly, 225 West 39th Street, New York.

Quick-Action Advertisements continued on page 17

Quick-Action Advertisements continued from page 16

AGENTS: Everybody uses extracts. Sell Duo Double Strength Extracts and complete line Household Necessities. Products used constantly. Big repeaters. Write today. DUO Co., Dept. E56, Attica, New York.

SALES District Managers wanted for Dominant Polish, the new wonder that is being adopted everywhere. If you have small capital, we can make you a remarkable offer, one that will put dollars in your pockets while you are making cents now. Exclusive Territory granted. Dominant Products Co., 43 South Street, New York City.

AGENTS: Clever invention! Inkspoon makes every pen a fountain pen. Best office seller. Big profit, demand increasing everywhere. Exclusive territory offered. Sample free. H. Mears Company, Tribune Building, New York.

ATTRACTIVE openings for men and women who have time to build up a permanent and lucrative business of their own. No experience necessary. Sell protection against death and loss of income from accidents and sickness. $7,500 death benefit, $25.00 weekly, costs $10.00 yearly. Other amounts in proportion. Guaranteed income from renewal commissions. Easily sold to occupations insurable at one rate. No collecting. Oldest... Resources, established 1886. North American Co., 320 Walnut St., Philadelphia.

AGENTS: We pay $6 a day taking orders for New Kerosene Burner. Fits any stove. Burns coal oil. No experience or capital required. Work spare time or full time. Write for demonstrating sample. Thomas Mfg. Co., Class 200, Dayton, Ohio.

100% PROFIT selling Three-in-One Holder. New patented, small, universally useful article. Very fast seller. Rubber Steel Products Corporation, 1211 Engineering Building, New York.

BE independent. Work for yourself. Sell auto specialties. Make real money. Particulars free. Fairbanks's Chemical Works, ..., Oklahoma.

MONEYMAKING Books, Plans, Formulas. Catalogs Free. Ideal Book Shop, 5501 P. North Robey, Chicago.

SEND for free sample Fresnot Washday Wonder. Be convinced you can do a whirlwind business. Constant repeater with large profits. You take no chance. We positively guarantee sale. P. B. Mosser & Sons, 30 E. Jackson Boulevard, Chicago.

POMET Polishing Cloth cleans all metals. Retails 25c. Sample free. F. C. Gale, 3 Edinboro Street, Boston.

GENUINE Buckskin gloves direct from factory $1.75. Made from skin of choice. Agents wanted. Quality-Argus Co., Box 30, Gloversville, New York.

PREPARE and Market Your Own Products—Master formulas, manufacturing processes, trade secrets, commercial information. Particulars free. The Thealy Co., Dept. ..., Washington, D. C.

MR. ADVERTISER: Ask to-day for a copy of the "Quick-Action Advertising Rate Folder." It contains some really important facts which will prove interesting and valuable to you. It also tells "How You Can Use Popular Science Monthly Profitably." You'd like to know, wouldn't you? Manager Classified Advertising, Popular Science Monthly, 225 West 39th Street, New York.

HELP WANTED

OUR genuine gold window sign letters are an excellent money-making proposition for handy men. Mono Sign System, 2340 St. Antoine, Detroit, Michigan.

MEN. Age 17 to 45. Experience unnecessary. Travel, make secret investigations, reports, salaries, expenses. American Foreign Detective Agency, 32?, St. Louis.

RESILVER mirrors, French plate taught. Easy to learn. Immense profits. Plans free. Wear Mirror Works, Excelsior Springs, Missouri.

MEN wanted to make secret investigations and reports. Experience unnecessary. Write J. Ganor, Former Govt. Detective, St. Louis.

WRITE Photoplays $50 each. Experience unnecessary. Details free. Producers League, 194, St. Louis.

$133 Month. Railway Mail Clerks. Hundreds wanted. Steady. List positions free. Write immediately. Franklin Institute, Dept. 542, Rochester, New York.

BIG Money Made Silvering Mirrors, metal plating, refinishing. Outfits furnished. ... Laboratories, 356 Fifth Avenue, New York.

DETECTIVES Earn Big Money. Excellent opportunity. Travel. Fascinating work. Experience unnecessary. Particulars free. Write American Detective System, 1968 Broadway, New York.

GOVERNMENT Clerks Needed Soon (men—women) $1600—$2300. No experience required. Write Mr. Ozment, former U. S. Government Examiner, 398, St. Louis, Mo.

MEN to represent corporation by interviewing business men at home or traveling. Nothing to sell. Equipment furnished you free. Earnings from $2000 to $6000 yearly. Popular, 1460 White Plains Ave., New York.

BE a detective. Excellent opportunity, good pay, travel. Write C. T. Ludwig, 424 Westover Bldg., Kansas City, Missouri.

BE a Mirror Expert. $3-$10 a day, spare time at home. Small capital, we train. Start mirror making and silvering mirrors. French method. Free prospectus. W. F. Derr, Pres. 579 ... Street, New York.

BE a Railway Traffic Inspector. $110 to $250 monthly, expenses paid, after 3 months' spare-time study. Splendid opportunities. Position guaranteed or money refunded. Write for Free Booklet CM-13. Standard Business Training Institute, Buffalo, New York.

FIREMEN, brakemen, baggagemen $140-$200. Colored porters by railroads everywhere. Experience unnecessary. 832 Ry. Bureau, East St. Louis, Illinois.

STOP done grind. Start silvering mirrors, auto headlights, tableware, etc. Plans free. Clarence Sprinkle, Dept. 98, Marion, Indiana.

HAVING sold 50,000 of a household appliance in New England we are ready to make general offer whereby direct salesmen are now averaging $60 weekly. No capital required. Unique method of obtaining interviews. Opportunity for District Management. The Ravess Company, 53 Broad Street, Milford, Connecticut.

WANTED: Representatives to handle household novelties. Grand opportunity to work way through Elm Commercial College. Students Aid Sales Department, Newark, New York.

BUILD a Sign Business. Experience unnecessary. Send $1.00 for sample and your home equipment information. Imperial Sign Company, 203-B, District National Bank, Washington, D. C.

Become a Motor Expert

Learn Autos in Washington

Earn BIG Money as an Auto, Truck, Tractor or Airplane Mechanic

FREE Catalog and Book of Views of Washington

Trained mechanics earn $150 to $400 a month and many are earning $5,000 to $10,000 and MORE a year in THEIR OWN BUSINESS. We fit you in our New school to MAKE REAL MONEY in 4 to 6 weeks.

Careful authorities estimate that more than ONE BILLION DOLLARS were spent in 1921 for the care and repair of the nine and one-quarter MILLION motor vehicles registered in the United States. If you are one of the millions who has been out of a job this year, or if you are dissatisfied with your earnings, get into the trade that knows no lay-offs—a trade that pays big money all year round.

Marvelous $250,000 Schools

Our new $250,000 Schools have every equipment and apparatus for successfully teaching you. E. H. Cooley, our Vice-President and CHIEF INSTRUCTOR is a designer of motors, an electrical engineer, has been in charge of machine shops, has taught electricity, and is one of the most thoroughly informed inspectors in the country.

Learn Through ACTUAL WORK

Our method of teaching puts you on the actual kind of work that you will have to do when you are in a garage or repair shop working at wages of $150 to $400 a month. Our complete instruction INCLUDES transmissions, engine assembly, starting and lighting systems, carburetion, welding, cutting, forging. In fact, we teach you ALL that you MUST know if you are to be rated as a first-class auto mechanic.

SPECIAL LIMITED TIME Tuition Rate

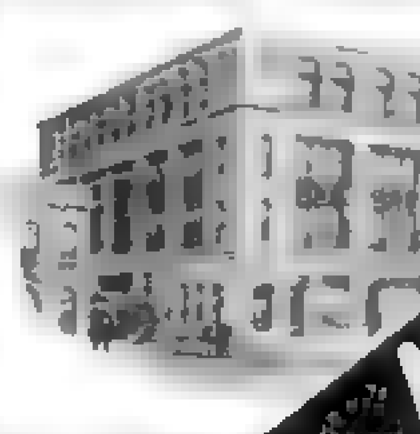
EARN $150 to $400 a Month.

To quickly enrol one thousand students we have made a very LIBERAL REDUCTION from our regular rate. We reserve the right to withdraw this offer at any time.

HERE IS YOUR OPPORTUNITY to learn to be an auto mechanic and visit and see Washington at the same time and at a very low cost. Decide to make the trip that you have always wanted to take and to learn the trade that you have always wanted to learn. Train for independence, prosperity and success NOW. Come to Washington.

FREE New Catalog and Book of Views of Washington

Before you decide on ANY school ANYWHERE, BE SURE TO READ OUR CATALOG. It contains just the information you MUST have before you can decide fairly for your own best future.



AMERICAN MOTOR SCHOOL
1612-1622 U St. N.W. Washington, D.C.

MAIL THIS COUPON TODAY

American Motor School, Inc., Dept 113
1612-1622 U St., N. W.
Washington, D. C.

Without cost or obligation, please send your catalog and "Washington Views."

Name

Address

City State Age

DO YOU LIKE TO DRAW?

Cartoonists are well paid

We will not give you any grand prize if you answer this ad. Nor will we claim to make you rich in a week. But if you are anxious to develop your talent with a successful cartoonist, so you can make money, send a copy of this picture, with 6 cents in stamps for portfolio of cartoons and sample lesson plate, and let us explain.

The W. L. EVANS SCHOOL OF CARTOONING
825 Leader Bldg. Cleveland, Ohio

HEAVEN and HELL

By Emanuel Swedenborg

This book of 632 pages, or any of the following works of Swedenborg, printed in large type on good paper, well bound in stiff paper covers, will be sent, prepaid, on receipt of 15 cents per book.

Divine Providence - - 629 pages
The Four Doctrines - 635 pages
Divine Love and Wisdom, 618 pages

The American Swedenborg Printing and Publishing Society

Room 764 **3 W. 29th STREET** *New York*

LEARN ELECTRICITY IN 3 MONTHS

IN THE GREAT SHOPS OF

Intensive, individual and practical instruction in America's greatest and best equipped trade school. Master Craftsmen always at your side to guide you.

ELECTRICAL EXPERTS EARN BIG PAY

Big demand for trained electricians now. Come to the

COYNE SCHOOL

Many students earn way while learning. Free Employment Department Service. Free Automotive Electrical Course and Complete Course in Business Management to students enrolling now at our Complete Electrical Course. No extra charge ... Chicago offers you a wonderful opportunity for recreation and study. Send for Coyne's Book of Opportunities. ...

Write Today

Coyne

Trade and Engineering Schools
... E. Illinois St., Chicago, Ill.
Dept. 39

Quick-Action Advertisements continued on page 18

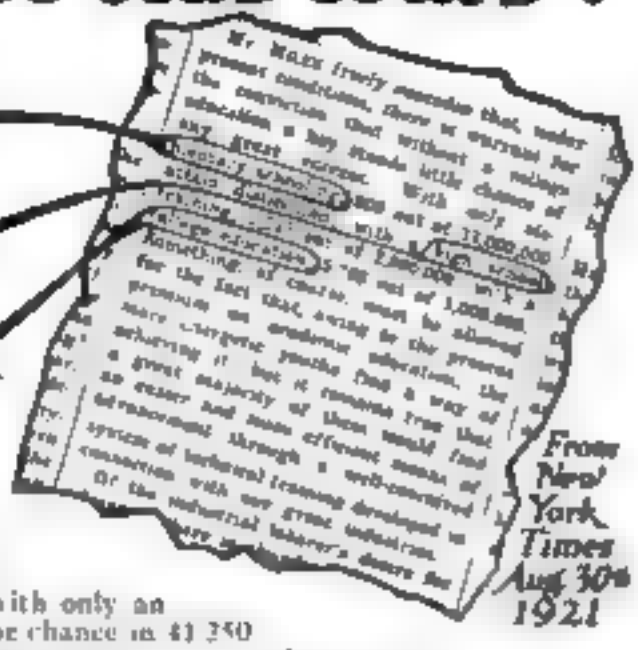
Trained Minds Win

What Chance Has Yours?

1 Chance for Success

9 Chances for Success

238 Chances for Success



Thus does a great newspaper comment editorially on a recent report on industrial education made to the American Society of Mechanical Engineers.

Think what these figures mean! With only an elementary education, you have just one chance in 1,250 to achieve success. A high school education increases your chance nine times. With a college education, or its equivalent, you multiply your chance by 238.

Only a few men out of every thousand can go to college or to a good technical school. The great majority must find some other way of getting a special education.

The United Y. M. C. A. Schools furnish one reliable way of doing this through the use of *spare hours without giving up present employment*. Thousands of superintendents, foremen, department managers, engineers, accountants, salesmen, business executives, etc., owe their positions to spare-hour study under Y. M. C. A. direction.

In the 240 United Y. M. C. A. Spare-Hour Courses there is one to fit your need. United Y. M. C. A. correspondence instruction gives you: (1) top-notch service for the least money; (2) careful guidance in selecting a course; (3) the personal, sympathetic attention of an earnest instructor; and (4) as much encouragement to complete your course as to begin it.

During the last twelve months more than 140,000 ambitious young men have enrolled with the United Y. M. C. A. Schools. Advance with them. Don't dodge along in poorly paid or distasteful work when the world is demanding trained heads, men able to take positions as leaders, who can create, execute and direct.

Multiply Your Chances Of Getting Ahead

Send this inquiry coupon. You will receive interesting details of the course of your choice, also a free copy of our new booklet "Does Education Pay?"

UNITED Y. M. C. A. SCHOOLS, Dept. B-B, 315 Lexington Ave., New York City

I am interested in the position or home study course I have marked. Please give full information.

Accountant
— Advertising Man
— Agricultural Courses
Applied Psychology
— Architect
Auto Mechanic
Banking
Brick Layers
Bookkeeper
Building Construction
— Business English
— Business Law
Business Organization
Chemistry
— Civil Engineer

Civil Service
Commercial Spanish
Concrete Engineer
Dairy Farming
Draftsman
Electrician
Electrical Engineer
English Courses
Factory Management
Farm Management
— Farm Motor Mechanic
— Foreign Languages
Foremanship
Freehand Drawing
— Highway Engineering

Illustrating
Locomotive Operation
Machine Shop Practice
Mathematical Courses
Mechanical Engineer
Plumber
Practical Engineering
Radio Operator
Radio Engineer
Railroad Engineering
— Salesman
— Secretarial
Steam Engineer
Stenographer
— Structural Drafting

— Surveyor
— Textile Designing
Traffic Management
— Use of the Slide Rule

Name and Occupation ..... (Please Write Plainly)

Complete Address

HIGHER EDUCATION

HOME STUDY

Courses in English, Spanish, Mathematics, Chemistry, Drawing, Education, Business and in 35 other subjects are given by correspondence. Begin any time.

The University of Chicago

Division 31, Chicago, Ill.

WANTED! RAILWAY MAIL CLERKS

Examinations soon. $1600 to $2300 a year. Steady lifetime job. Common education sufficient. No "pull" necessary. Mail coupon for Catalog.

Patterson Civil Service School, Dept. 1612, Rochester, N. Y.

Gent: Send me without charge your Catalog, describing this and other fine U. S. Government positions.

Name.

Address.

Popular Handbook for Cement and Concrete Users

A book of plans for the concrete and stucco kinds of repairs employed in construction, whether of foundations, inspection and testing, waterproofing, coloring and painting, ruins, tablet work, and tool data.

430 pages, 378 illus. Price, $3.00

POPULAR SCIENCE MONTHLY 225 W. 39th St., New York

Our Scientific Method will stop that

STAMMER

Send for ... It tells how we can permanently stop stammering or stuttering in a few weeks time. A natural (unassisted) method.

The Lewis School for Stammerers

56 Lewis Bldg., 73-77 Adelaide St., Detroit, Mich.

CARPENTERS, Bricklayers, Machinists, Electricians, Plumbers, Pipefitters, Boilermakers, Sheet Metal, Shipyard, Concrete, Structural Workers and others can now read Blue Prints. Home study book. It will help you hold your job. It will get you a better job. It will save you doubt, money. Write for Catalog B, stating trade.

We also teach drafting. Be a draftsman. Earn big money. We train you quickly. Easily and cheaply. Write for Catalog C.

Columbia Correspondence School Est. 1904

Dept. 27, Drexel Bldg., Phila., Pa.

Quick-Action Advertisements continued on page 19

GOVERNMENT needs Railway Mail Clerks, $1600 to $2300 annually. Write for free specimen questions. Columbus Institute, Columbus, Ohio.

WANTED: Men to prepare for positions as Mechanical Draftsmen under personal supervision of Chief Engineer. Box 45, 50 Church, New York.

SEE ADVERT. ON PAGE 20. Ask Sheda, for a copy of the Quick-Action Advertising Rate Folder, containing some real educational facts which will prove interesting and valuable to you. Sells the New York and Pacific Popular Science Monthly Profitably. You'd like it. Address Sheda's Office, Manager, Classified Advertising, Popular Science Monthly, 225 West 39th Street, New York.

BUSINESS OPPORTUNITIES

BUTTONER Machine, Alliance, Ohio, prints big profit schemes. One subscriber made $25,000 from his. Sent on offer $10 bill from one. Try your luck. Year 6.00; 3 months 2.

CHEAP correspondence courses sold, rented and exchanged. List free. (Courses bought.) Lee Mountain, Pisgah, Alabama.

SUBSTANTIAL manufacturing corporation, Worth capacity cash, is seeking branch and jobbing salesmen. Big upward movement. With office equipment to capitalize as established. Address, Secretary, 343 N. Paca, Baltimore, Maryland.

INVENT. Secure with Patent Formula and Trade Secrets all types. Info free. W. L. Cummings, Ph.D., Lincoln Avenue, Syracuse, New York.

BE a detective. Large profit opportunity, good pay. Special Service, 3 Lafayette, 424 Westover Bldg., Kansas City, Missouri.

GENUINE ... Scientific methods ... Guaranteed ... Robert Graham, Stokes, 1001 Dallas, Texas.

LEARN ... Business ... Free booklet ... Alex Hill, College, New York.

INVENTOR a new business. Earn $3,000 to $6,000 yearly in professional free making and selling a final specialty, operating on a capital of $4 to $50. Sale on full or trial, easily tested by any one at home in a few weeks, at small expense. No further capital required. No goods to buy, no selling with long or series. Additional opportunity Laboratory, 75 Stock Exch. Building, Massachusetts.

We start you in business furnishing everything. Sparetime work. $3 to $10 per day. Operating your own business. Capital required. Booklet free. H. Hazelwood Company, East Orange, New Jersey.

SPECIALTIES. Excellent opportunity. Spare or full time work. Experience unnecessary. Particulars free. W. Hoe American Drive, Chicago (Hoe Building), New York.

WE ... will pay you to write show cards for us. No canvassing or soliciting. Any supply ... steady work. Distance no object. Will pay ... Write Kelvin, Limited, Dept. ... 84 East Richmond, Toronto, Ontario.

PATENTS. Book free. Highest values for free opinion of patentable nature. Talbert & Talbert, 422 Talbert Bldg., Washington, D. C.

BUY and exploit practical inventions. Trade for stock, patent companies and royalty rights. Adam Parker, Bldg., St. Louis, Missouri.

PATENTS. Protect Trade Marks. Registered. A member-lawyer experienced in patent office for the protection and development of your ideas. Preliminary advice cheerfully furnished without charge. Booklet of information and form for disclosing ideas free on request. Richard ... Washington Building, Washington, D. C. or 2278-E Woolworth Building, New York.

BUSINESS a Magazine, capital $1, sample 10c. Copy Box 11, Bethalto, Illinois.

DYE and clothes cleaning parlor in home town. Wonderful opportunity. Big profits. Write Dyeco, Box 37, Station F, New York.

ADVERTISE 25 words to 50 weeklies, $3.00; each additional line of 7 words or less, $1. Catalog free. Union Sales Co., 33 Arch Street, Philadelphia, Pennsylvania.

ARTIFICIAL Marble, sanitary flooring, interior tiling, ornamental coating, Cuticrete plaster, stylish furniture, decorations, statuary, Kuliber moulds, Electro-chemical factory. Particulars and illustrations free. Chris Mahler, Box 1133, Washington, New York.

START a growing cleaning and dyeing establishment, big profits, little capital. We tell you how. Write for booklet. Pro-Vonde System, Dept. 3, Charlotte, North Carolina.

MAKE and sell your own goods. 1,000,000 Industrial Receipts. Mechanics, manufacturers, farmers, doctors, medical, technical and practical, trade secrets, processes in every business, 500 engravings, 1,000 pages, fine cloth, delivery $3.00. P. Dembel Co., 948 Jefferson Ave., Cleveland, Ohio.

A HIGH CLASS Man able to finance himself will be given a valuable exclusive sales contract for Renville Auto Refrigerators for home use, nationally advertised, $5,000 to use. Splendid opportunity to build permanent profit producing business. Write Renville Electric Co., 612 Marquette Building, Detroit, Michigan.

NICKEL. Plate automobile accessories, hardware, electrical parts. Big profits. Requires no capital. Simple battery process. Write today. Webster Engineering Co., Webster Groves, Missouri.

I MADE $30 a week baking French bread-making 15 years experience. Free booklet tells. Ashbrook, E. 67 Warren, Ohio.

LET'S swap! Buy, Sell. Want to sell? Want to buy? Want? Have things results! Swap Bulletin, 1635 Bathgate Ave., Bronx.

START a business in your kitchen. Write Chas. Mirbach, 1403 Winchester, Chicago.

AN attractive proposition is offered persons desiring a better future. The Aetna Company, 6007 Collins Ave., Philadelphia, Pa.

TO Amateurs in Towns of 100,000 or less. Listen. Are you interested in making money in your spare time? Write us, tell us your age and standing with your local radio field. The information you furnish us will determine whether you are qualified to receive an interesting and reasonable proposition from us. Address Radio Dept. Federal Telephone & Telegraph Co., Buffalo, New York.

Quick-Action Advertisements continued from page 18

STAMPS AND COINS

LIKE Triangular stamps? To introduce our [illegible] Service Approvals we'll send triangular [illegible] set [illegible] ships [illegible] United States revenue, also packet 25 foreign, millimeter scale, perforation gauge, ruler and bargain lists, for only 6c. Fennell Stamp Company, Department C, Fullerton Building, St. Louis, Missouri.

CALIFORNIA gold 1/4 size 27c, 1/2 size 53c. White [illegible] and Catalogue, 10c. Norman Shultz, Colorado Springs, Colorado.

1000 different stamps, $3.00; 500 $1.25; 200 25c; 100, 12c. Approvals. Michaels, 5602 Prairie, Chicago.

CALIFORNIA Gold, quarter size and German [illegible] 10c; Villa note and catalog 10c. Homer Shultz, Union Star, Missouri.

50 Genuine Foreign Stamps, [illegible] War Issues, Venezuela, Salvador and India Service, Guatemala, China, etc. only 10c. Finest approval sheets 50% to 60%. Agents wanted. Big 72-p. Lists Free. We buy stamps. Established 25 years. Hussman Stamp Company, Dept. 55, St. Louis, Missouri.

STAMPS. 600 different $1.25; 300 [illegible] cents; 200 25 cents; 100, 10 cents. List free. Approvals for reference. Elwood D. Weber, 812 South Avenue, Plainfield, N. J.

STAMPS 20 unused. All Different, 2 cents. Mention paper. Quaker Stamp Co., Toledo, Ohio.

STAMPS, 50 varieties, Africa, Brazil, Peru, Cuba, Mexico, etc., and Album 10c. 50 different U. S. 25c. 1000 hinges, 10c. [illegible] List free. I buy stamps. [illegible], 5[illegible] Cote Brilliante, St. Louis, Missouri.

FIRST [illegible] Colonials 25 different, only 10c. [illegible], 1[illegible] Florida Avenue, Washington, D. C.

35 A[illegible] DIFFERENT stamps [illegible] Japan, French Colonies, etc. given to applicants for our high grade approval selections. Send references and [illegible] stamp to the [illegible] Stamp Company, Dept. 54, Milford, Connecticut.

[illegible] coins large full selling catalogue of coins for sale free. [illegible] premium [illegible] prices paid for coins, ten cents. William Hesslein, 10[illegible] Tremont Street, Boston, Massachusetts.

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Statement of the ownership, Management, Circulation, etc., required by the Act of Congress of August 24, 1912, of Popular Science Monthly, published monthly at New York, N. Y., for October 1, 1921. State of New York, County of New York, ss. Before me, a notary public in and for the State and county aforesaid, personally appeared O. B. [illegible], who, having been duly sworn according to law, deposes and says that he is the Business Manager of the Popular Science Monthly and that the following is, to the best of his knowledge and belief, a true statement of the ownership, management, etc., of the aforesaid publication for the date shown in the above caption, required by the Act of August 24, 1912, embodied in section 443, Postal Laws and Regulations, printed on the reverse of this form, to wit:

1. That the names and addresses of the publisher, editor, managing editor, and business managers are: Publisher, The Modern Publishing Company, Inc., 225 West Thirty-ninth Street, New York, N. Y.; Editor, Kenneth W. Payne, 225 West Thirty-ninth Street, New York, N. Y.; Managing Editor, Kenneth W. Payne, 225 West Thirty-ninth Street, New York, N. Y.; Business Manager, O. B. Capen, 225 West Thirty-ninth Street, New York, N. Y. 2. That the owners are: The Popular Science Publishing Company, Inc., 225 West Thirty-ninth Street, New York, N. Y. Stockholders of Popular Science Publishing Company, Inc.: Henry J. Fisher, 22 William Street, New York, N. Y.; Oliver B. Capen, 225 West Thirty-ninth Street, New York, N. Y.; Robert [illegible], 6[illegible] Plainfield Avenue, Summit, N. J.; Waldemar Kaempffert, 6[illegible] Fifth Avenue, New York, N. Y.; George H. [illegible], 22 William Street, New York, N. Y.; Susan D. [illegible], 22 William Street, New York, N. Y. 3. That the known bondholders, mortgagees, and other security holders owning or holding 1 per cent or more of the total amount of bonds, mortgages, or other securities are: [illegible], New York, N. Y.; Samuel Insull, Chicago, Ill. 4. That the two paragraphs next above, giving the names of the owners, stockholders and security holders, if any, contain not only the list of stockholders and security holders as they appear upon the books of the company but also, in cases where the stockholder or security holder appears upon the books of the company as trustee or in any other fiduciary relation, the name of the person or corporation for whom such trustee is acting, is given; also that the said two paragraphs contain statements embracing affiant's full knowledge and belief as to the circumstances and conditions under which stockholders and security holders who do not appear upon the books of the company as trustees, hold stock and securities in a capacity other than that of a bona fide owner; and this affiant has no reason to believe that any other person, association, or corporation has any interest direct or indirect in the said stock, bonds, or other securities than as so stated by him.

(Signed) O. B. Capen, Business Manager.

Sworn to and subscribed before me this 7th day of October, 1921.

Arthur A. Blauvelt, Queens County—1[illegible], New York County—[illegible], New York Reg. [illegible]

(Seal.) My commission expires March 30, 1923.

His New Invention Finds and Corrects Your Mistakes in English!

AS the result of thousands of tests, Sherwin Cody found that the average person is only 61% efficient in the vital points of English. In a five minutes conversation, or in an average one page letter, from five to fifty errors will appear. It is surprising to see how many experienced stenographers fall down in spelling such common words as "business," "abbreviate," etc. It is astonishing how many business men say "between you and I" instead of "between you and me," and use "who" for "whom" and mispronounce the simplest words. Few people know whether to use one or two "c's" or "m's" or "r's," whether to spell words with "ie" or "ei," and when to use commas in order to make their meaning absolutely clear.

Sherwin Cody

A Remarkable Discovery

Mr. Cody has specialized in English for the past twenty years. But instead of going along in the old way he has applied scientific principles to teaching the correct use of our language. He made tens of thousands of tests of his various devices before inventing his present method. In all his tests he found that the trouble with old methods is that points learned do not stick in the mind. In school you were asked to remember rules, and if you forgot the rules you never could tell what was right and what was wrong. For the past five years Mr. Cody has worked almost day and night to find a way to replace bad habits in writing and speech, with good ones. And as a result of his experience he evolved his wonderful new

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Popular Science Monthly

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25 Cents a Copy; $3 a Year

Published in New York City at
225 West Thirty-ninth Street

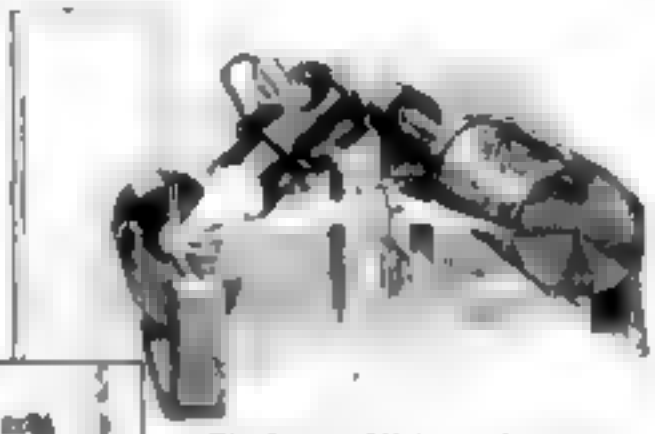
19463

How the World's First Wireless News-Picture Was Flashed Across the Atlantic Ocean

Paris gets President Harding's portrait in twenty minutes

By Wilfred S. Ogden

LAST January Popular Science Monthly described the apparatus by which Edouard Bélin had sent photographs by telegraphy. By midsummer M. Bélin had realized improvements predicted in our first article, and was able to undertake transoceanic wireless of pictures and handwriting! You are sure to find fascinating information in the following account of his new apparatus.



The beam of light at the receiving station is controlled by the radio impulses sent out from the transmitting station. Bélin's greatest problem was to make sure that the two cylinders located thousands of miles apart revolve at the same rate. A system of electric chronometers connected with the radio outfits solved the problem

WHILE the crowds are still filing out from the football field, theater audiences in cities a thousand miles away are watching actual motion-pictures showing the last plays of the game!

Do you call that merely a fantastic dream?

Wouldn't you also have said only a few months ago, that the scheme of flashing a man's portrait by wireless across the Atlantic Ocean was merely a fantastic dream?

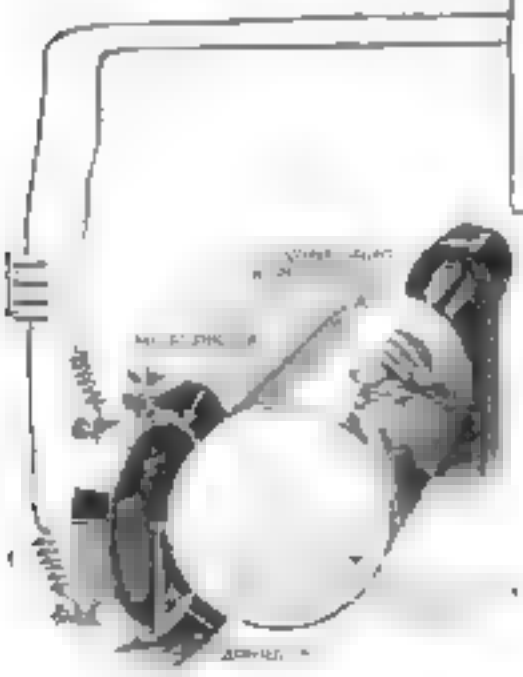
Yet this amazing feat is actually one of the miracles wrought by science in 1921! A picture of President Harding in action was wirelessed from Annapolis to Paris in the space of twenty minutes! How many people are familiar with the imagination-stirring details of this pictorial conquest of space? How many even know that it occurred?

The Miracle Picture of the Year!

Here is the first important news-picture ever to be sent by wireless. It is an action portrait of President Harding, exactly as it was received in Paris, twenty minutes after M. Edouard Bélin's radio apparatus had started sending it from Annapolis

Somewhat crude, but wholly recognizable, was the Harding portrait as received at the Paris end; and surely from the germ of this first wireless picture, progress to future radio broadcasting of moving news-photographs while the events pictured are actually taking place seems no more impossible than many another modern miracle that has been accomplished by science.

In general, the wireless outfit with which M. Edouard Bélin sent the Harding picture is the same as that with which he sent pictures over telephone and telegraph wires, as described a year ago in Popular Science Monthly. A new method, however, is utilized to keep the two cylinders, thousands of miles apart, revolving at exactly the same rate of speed. On one of the cylinders is pasted the picture to be transmitted, and sensitized paper on the cylinder at the other end is acted on by a beam of light, reflected under the control of radio waves, which are, in turn, governed by a needle moving over the sending cylinder. In wireless transmission, these



SENDING END

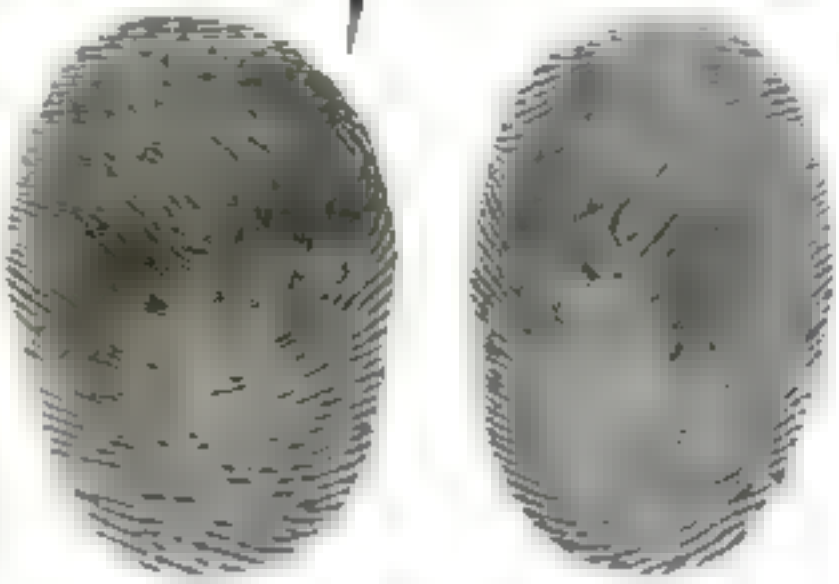
At the left is the cylinder with the chrome-gelatine print wrapped around it. The microphone point travels over the cylinder in the same way as the reproducer on the old type phonograph

cylinders are operated by small dynamos instead of by clockwork, and their uniform movement is assured by a regulating chronometer with electric contacts, which stops and starts the cylinders at each revolution. The simultaneous starting of the two cylinders would be assured by the two regulators if the latter could only be made to keep perfect time, but this condition cannot be realized. In order to overcome this difficulty, M. Bélin has devised the following method. At each liberation of the transmitting cylinder, the wireless station sends out a dot similar to the noontime signal. The receiving station does the same and the operator of the latter adjusts his apparatus until he hears the two dots simultaneously.

In sending pictures long distances by wireless, it has been necessary to reduce the cylinders' speed from two revolutions a second—the time for wire transmission—to one turn in four seconds, making the time required to transmit a picture twenty minutes instead of two and a half. Compensating for this delay, however, is the belief that Bélin's system may make wireless stations independent of electrical disturbances which frequently "ball up" ordinary wireless messages.

At certain hours and seasons, electrical storms drown the dots and dashes of the Morse signals, and produce so much interference that it is often necessary to repeat a message two or three times before it is comprehensible. These repetitions reduce the number of messages that can be handled by a wireless station, and most of the day's communications are crowded through in certain hours when atmospheric conditions are favorable. A message sent by Bélin's system, on the other hand, goes in facsimile, each letter being taken down at the receiving end in its characteristic written form. Even if "static" interferes with the transmission, enough of each letter will be reproduced to render the message legible. It is not necessary to make a photograph of the written message before sending it. The writer uses special ink that gives sufficient relief for the sending-needle to feel when the paper on which this raised message is written is rolled on the sending cylinder.

Another disadvantage of ordinary wireless which the Bélin apparatus does away with is the fact that any message sent by radio is practically howled out for all the world to hear. Engineers are hopefully at work on plans which will ultimately assure secrecy in wireless messages, but the fact remains that to-day practically any message can be heard by almost any wireless station that has the capacity to receive the sender's wave lengths.



Fingerprint reproductions, as received over the wire in Paris, three minutes after they had been taken from a captured suspect in the provinces. Thus is realized the prediction made by Popular Science Monthly last January, that the apparatus of M. Bélin would prove invaluable in running down criminals.

It would seem, in the case of M. Bélin's apparatus, that any given station likewise might capture the picture that was being sent, simply by tuning to the right wave length. The sending cylinder probably wouldn't correspond in speed of revolutions to the receiving cylinder that was "listening in," the photographic points would therefore be more spaced out or more closed up on the receiving cylinder than on the sending cylinder; but even so, there is still a chance that they would remain legible. However, if the transmitting cylinder revolved in an irregular way, stopping and starting at unexpected intervals, the result produced on a receiving cylinder turning uniformly would be an illegible scrawl. The points would be out of place both vertically and horizontally.

It is this little trick that M. Bélin expects to use for sending written messages in secret. He is perfecting a compact secret-message apparatus that can be kept upon any desk. With an equipment of this kind, the foreign representative of an American business house could write personal messages to his home office, to be transmitted from the cylinder on his desk by telephone, cable, or wireless. Using a rhythm of revolutions agreed upon by code, he could be certain that nobody except the operator of the receiving cylinder that was adjusted to the secret rhythm could understand a word.

World-important diplomatic interchanges, when this system is finally perfected, will be carried on by an actual exchange of authentic handwritten documents, carried broadcast through the air, yet secret from all but sender and receiver, while men in New York will be able to close important deals in San Francisco, instantly transmitting endorsed checks and signed contracts across the continent.

Machine Ties Parcels as Reaper Binds Grain

ELEVEN years ago J. J. Bachmayer was in the vegetable business. His fingers got so sore tying bunches of onions and radishes, that he determined to invent a parcel-tying machine. A year later he built the first machine out of old junk and bicycle sprocket wheels. For seven years he struggled to get people to use it, but it was not until 1917, when a machine was developed for tying candy-boxes that the company had any great success.

The machine is electrically operated. A box or parcel which is to be tied—the length or width does not matter but the height must not exceed five and a half inches—is passed over the metal tray which pulls the twine around one way, and ties a neat, strong knot without waste of cord. To tie the package both lengthwise and crosswise it must be passed through the machine again.

The tying action is based upon that of a self-binding reaper, but this machine ties the twine tightly in the first place, instead of tying a knot in a loose cord while the straw is compressed, and relying upon the expansion of the bundle to tighten the knot.

Watch for These Features Next Month

Travel by Pullman Auto Bus
How Music-Rolls are Made
Trawler Seeks Sunken Treasure
Your Family's Heredity Chart
New Japanese Plane-Carrier
Subway 400 Feet Below Surface

Cylinder on Automobile Wind-Shield Contains Sunshade

THOSE who find their pleasure behind a steering-wheel will appreciate this sunshade, which is neat and compact and unobtrusive when not in use. The driver is shown pulling it across the wind-shield where it is hooked to a special attachment. The shade is of green silk.

When unhooked, the shade flies back into its container. No screws are needed to attach this accessory, as it is provided with clips which snap instantly over the ends of the wind-shield.

Earth to Plow through Broken Comet's Wreckage

How science explains November meteor shower

EARTH's biggest adventure this month [illegible] with a sort of [illegible] a vast sweeping path through [illegible] comet's [illegible] whose [illegible] fragments rush [illegible] at [illegible] when we furnish one of the regular November showers of shooting stars.

[illegible] of meteors [illegible] November [illegible] average meteor.

[illegible] explained [illegible] rush through [illegible] that [illegible] the same time each year [illegible] November [illegible] are the remains of [illegible] comet [illegible] the [illegible] from [illegible] space [illegible] broken up under the [illegible] pounds [illegible] resulted in [illegible] [illegible] half times the earth's [illegible]

When [illegible] the [illegible] the largest [illegible] separating them was 60,000 [illegible] the distance [illegible] 000 miles [illegible] spreading [illegible]

How Scriven Bolton, famous astronomer, pictures the earth's annual November rush through the vast shoal of meteor fragments left by Biela's lost comet

Comet particles, myriads no larger than a pinhead, others sometimes bigger than a man, flash into flame as they strike our atmosphere and are quite burned up before reaching the ground

After this return the comet was never seen again [illegible] November [illegible] the fate of the earth's passage across the comet's orbit [illegible] of shooting stars [illegible] from [illegible] gas and it is thought [illegible] not [illegible] caused by [illegible] disintegrated [illegible] of the comet itself.

The fate of Biela's comet is not an isolated instance. Several cases on record show that the subdivision and [illegible] disintegration of many comets is not an uncommon occurrence. A comet's head is believed to be a mass of meteorites, ranging in size from stone and [illegible] rocks weighing many tons down to the finest powder or dust. Burned away from [illegible] when they [illegible] our atmosphere. Few of these fragments ever strike the earth, although [illegible] estimate that over 46,000,000 of them [illegible] upon us [illegible]

Where the "Last Discoverers" Are Now Seeking New World Riches for Mankind

Earth's few remaining unknown spaces are being "mopped up" by an unprecedented number of explorers

By Ralph R. Perry

WE are living to-day in the greatest period of exploration that the world has ever known. During 1921 hundreds of men have gone forth into the waste spaces of the earth seeking at the risk of their lives new wealth and knowledge for mankind's benefit.

Coal, oil, minerals, new medicines, and precious stones represent in part the objects of their search; but more than that, this vast after-the-war revival of exploration is apparently going to clean up earth's last remaining mystery spots.

With one or two exceptions the hundreds of explorers in the field to-day are not striving for spectacular goals of discovery. Rather, they are consolidating the gains in our knowledge of outlying portions of the globe made by the Pearys and the Scotts who went before them. They are "mopping up" the earth.

The last objectives to which the explorer has yet to push are shown on the accompanying map, the black portions of which represent large areas of the earth of which we know absolutely nothing.

This year sees Lieutenant-Colonel Bury on his way to climb Mount Everest, the world's highest mountain and the one really spectacular goal left since the winning of the poles. Parties will soon push into the virgin wilderness in the interior of New Guinea. Before long some exceptionally daring adventurer will cross the untrodden Arabian desert of Roba-el-Khali.

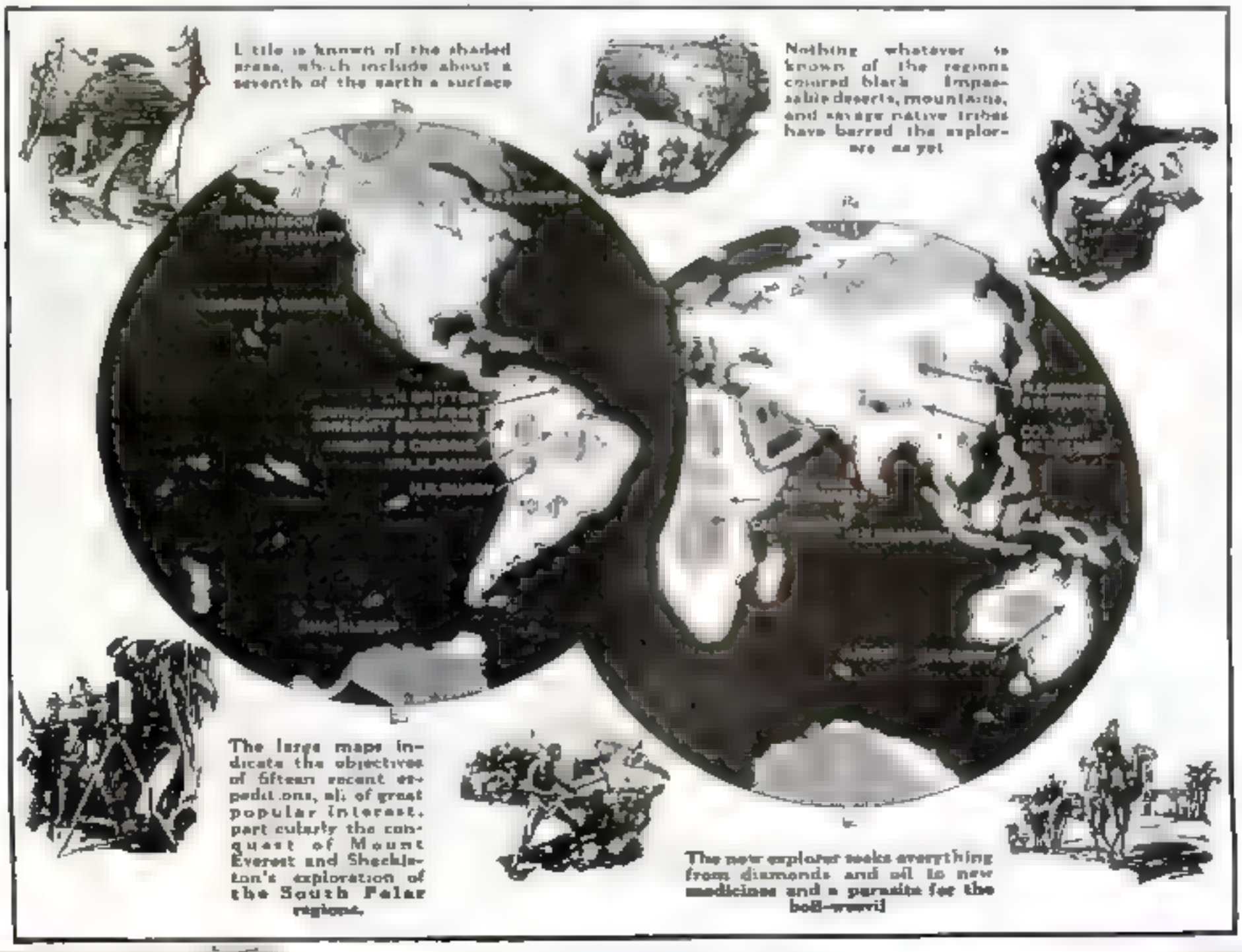
"Mopping Up" Arabia and India

Roba-el-Khali is shown on the map in the interior of southern Arabia. On its outskirts there are petroleum springs. What lies beyond, no one can say. There may be more oil there, but not even the native Arabs have crossed this waste of shifting sand and naked rock, blazing under a tropical sun that makes it the hottest portion of the earth's surface. If a man were to take young she-camels in full milk and push out in the spring, some explorers think that this waste might be crossed, but as it is 850 miles long and 650 miles wide, no one has made the attempt, as yet. It is the largest blank space on the map.

To the north our chart shows two smaller, divided dark spaces. These formed one area a few years ago, but this year travelers pushed through from north to south, and we now have some information on the country lying thirty miles on either side of the route.

At the foot of Mount Everest is the kingdom of Nepal, of which we know nothing except from the reports of natives. It is an independent Mussulman kingdom, and the maharajah refuses to permit a white man to set foot in his kingdom. A few men have penetrated the southern border, but only for a short distance. Even the party which is about to climb Mount Everest was refused the right to cross Nepal, and was forced to make a detour into Tibet and will climb the mountain from the northern side. Nepal will probably be the last unknown area on the map.

The same condition exists in the interior of New Guinea, where savages attack every exploring party that has left the coast. This island is owned by Great Britain, Holland, and France, and a combined expedition equipped for resisting the natives was about to set out when the outbreak of the war postponed the attempt.



The diminutive "*Quest*," only 111 feet long and 200 tons displacement, in which Sir Ernest Shackleton will survey the Antarctic. Balloons, a baby airplane, and special ocean sounding apparatus comprise part of the equipment carried

It is to be resumed in the near future, since the forests of the interior are believed to be rich in natural resources.

The largest unknown areas, of course, are those surrounding the poles, but the expeditions of Shackleton and Stefansson are constantly adding to our knowledge of these sections. Among the parties now seeking new knowledge in the Arctic is that of Donald B. Macmillan, which will make special studies of polar magnetism and the aurora.

How Little We Really Know

Outside of the Arctic, it is true, we know *something* about nearly all the rest of the earth—but in spots it is very, very little. Throughout the vast shaded areas on our map we know little more than the courses of the navigable streams. The whole of northern Canada is practically unknown, and what undreamed-of possibilities may lie there are hinted at by the recent discovery of oil on the Mackenzie. The same is true of Siberia, the Sudan, almost the whole of interior Africa, central Asia, and the deserts of Australia. When the French pushed into the Sudan, which was thought to be well mapped, they found streams and oases from fifty to a hundred miles distant from the points the maps declared them to be located—which would indicate that our geographical knowledge is nothing to boast of. In the valley of the Amazon there are three areas, each larger than the New England States, of which our knowledge is the slightest. Although Africa has been crossed and recrossed from end to end, the traveler is not surprised to find that water is often from one- to two-days' march from the points indicated on the map—which is apt to be fatal, in a dry country. If the day of the explorer is over, there was never such an opportunity for scientific expeditions.

These are made up of parties of five or six men sent out by the great museums and societies of the various nations. They live in the wilderness for months, even for years at a time. One man will make a careful map. A geologist will study the underlying rock strata, a zoologist gathers data on the plant and animal life, the anthropologist learns the habits of the primitive natives, the entomologist collects new species of insects, and when all have completed their work, scientists possess full and exact data on the conditions existing in the country, and the possibilities, if any, for commercial exploitation.

At the present time literally hundreds of these expeditions are in the field. We have shown some fifteen of the more important on our map. In the Antarctic, Shackleton is sailing in search of an island. The charts show two large islands in the Southern Pacific—Dougherty Islands and the Nimrods. Is there really any such land?

Nearly a hundred years ago whalers claimed to have sighted an island there. No one has ever seen it since. If the islands do exist, if it was not a mirage or a floating iceberg that was seen, the land would make a useful radio station in the chain which is rapidly encircling the globe. Shackleton intends to search until he either finds these islands or proves definitely that they do not exist. Then he will sail farther south to the Antarctic ice, to chart 3000 miles of unknown coast, to discover new sites for coaling, whaling, and wireless stations, and to make deep-sea soundings.

Scientific Research Inspires Explorers

The new spirit that has arisen in exploration since the discovery of the poles is manifest in the records of the two expeditions by Captain Scott. In the first, which was before the discovery of the South Pole, he simply made a dash to the farthest point south ever reached. This was pure exploration. In the second expedition, in which he lost his life, he was actuated by the newer scientific motives. His party had found thirty-five pounds of fossil bones that gave evidence of the life that existed in the Antarctic before the formation of the polar ice—specimens of incalculable scientific interest.

On his return, food failed, oil for heat gave out, his party was so overcome by privation and weakness that one of their number deliberately wandered out into the darkness to die in order to conserve the food supply of the rest. The men tottered toward their base camp and safety by pitifully short marches, discarding everything that impeded their progress—but to the very end they dragged those thirty-five pounds of fossils. They had set out for scientific evidence and knowledge, and although they died, the fossils were found in their last camp by the rescue party. It is this spirit that actuates the later-day ex-

(*Concluded on page 111*)

Civilization Must Abolish War

Prophetic pictures, based on statements by famous men,

These pictures reveal the alternatives to the prevention of another world war. Public opinion is awakening to the fact that unless the Washington Disarmament Conference pave the way toward peace, no mode of destruction will be barred in the next conflict

THE INVASION —"Fleets of fast-moving tanks equipped with tins of liquid gas, against which the enemy will [illegible] have no [illegible] will cross the frontier and obliterate everything living in the fields and farms, the villages and cities of the enemy's country. While life is being swept away around the frontier, fleets of airplanes will attack the enemy's great industrial and government centers. All these attacks will be made against the civil population in order to compel it to accept the will of the attackers." *Lieutenant Colonel Fuller*, Chief General Staff Officer of the British Tank Corps.

THE NEW TANKS —"They will be "organized in large units, with General Staff tanks, telegraph tanks, tanks carrying [illegible] will be armed with machine guns, and guns of all calibers." *General [illegible]*, Commander of the French First Army during the war.

LETHAL RAYS —"Imagine from the progress [illegible] made in the past that in the future we will not have recourse to gas and bombs, but employ every force of nature that we can, and there is [illegible] a great deal for progress in the [illegible] of [illegible] different forms of [illegible] arrested to lethal purposes which will shrivel up or paralyze or poison human beings if they are unprotected." *Major General Swinton*, British, one of the tank inventors.

The soldier of the next war will be clad constantly in gas armor made of impervious materials smeared with chemicals. The suit pictured was developed by the American army

or War Will Destroy Civilization"

show why disarmament is the great international problem

There will be no declaration of war. Hostilities will be inaugurated by myriads of airplanes and fleets of tanks. A few hours later will come gas bombardment of great commercial and industrial centers, killing hosts of civilians or driving them belowground

At least one great power is known to be at work on a machine by which lethal rays can be directed at the enemy's military and civil centers

THE BOMBARDMENT—"In 'the next war' this gas bombardment of capitals and great towns is not only a possibility but a strong probability almost a certainty" " . cellars will never form a defence against sinking lethal, cell-killing gases like lewisite and its probable successors.

"The shelters must be large enough to accommodate the people of a whole city; they must be deep enough in the ground to resist the enormous explosive force of the great new bombs; they must be gas-proofed, either by rendering them airtight and furnishing oxygen to keep the inmates alive, or by providing ventilators which make the outer air pass through an antidote.

"They must be as easily accessible as a subway—even more accessible. This virtually involves rebuilding modern cities, if the inhabitants expect to survive a war" . . . "Had the war continued, Paris would have been attacked from the air on a new plan.

"A first wave of airplanes would have dropped on the city roofs tons of small bombs which released burning phosphorus. . . . It would have started a conflagration against which the fire department would have been almost helpless, in a hundred quarters of the city

"Into the light furnished by this general fire the Germans proposed to send second and third waves of airplanes loaded with heaviest bombs. . . . From that the gas bombardment would have been but a short step." — *Will Irwin*, famous war correspondent, in "The Next War."

Railroads Use Motor-Buses to Improve Service

Motorized equipment now used on short lines is designed to compete with highway buses

RAILROAD passengers may soon be riding in a new type of gasoline-driven car which will operate over many short branch lines and interurban routes more cheaply than steam or electric trains.

After various makeshift experiments with auto-trucks converted into passenger coaches, the railroads have begun to feel the need of a standardized rail-car that will regain for them their lost short-haul traffic. Several truck manufacturers are now experimenting with vehicles of this type, and one particularly interesting model has just been put upon the market. It is a significant advance in the never-ceasing struggle for cheaper and more convenient transportation

This Car Is a Hybrid

The new car is neither a motor-truck with flanged wheels nor a railway-car with a gasoline engine, but rather it is a happy and sensible combination of the best elements in both. Its power plant, consisting of engine, clutch, transmission and their accessories, is founded on motor-truck practice, but the wheels, brakes, the body, and its appointments are "railroad style"

Gasoline-driven railway-cars are not new; neither are motor-buses with railway wheels. But a hybrid vehicle combining the best features of both is as novel as it is interesting. It represents a deliberate attempt by one of the leading truck manufacturers to get railway business, and to get it by giving the railroads something that they want acutely but heretofore have not been able to buy; to wit: a thirty-one-passenger vehicle that can be run for fifteen cents a mile, or a thirty-six-passenger-and-baggage car that can be run at twenty-five cents a mile, including interest on investment and depreciation charges. It costs one dollar and fifty cents to two dollars a mile to operate a railroad-train of two or three cars, each car having a seating capacity of seventy passengers. Railroads that are losing money on short-haul passenger traffic have already found that a gasoline rail-car will turn losses into profits. As an example, there is a sixty-mile railroad in the western part of New York State, serving a rural population of about ten thousand. The volume of passenger traffic is not sufficient for profitable operation of one train a day in each direction. Therefore, no passenger service is offered, although there is a freight-train every other day. The rail-car makes passenger transportation economically feasible on this road Assuming one car makes a round trip each way, a total of one hundred and twenty miles, at fifteen cents a mile, the total cost is eighteen dollars, and if an average of only twenty passengers is maintained, at three cents a mile the revenue is seventy-two dollars a day, or a profit of fifty-four dollars. Furthermore, there is no question but that much additional business might be obtained by making several trips a day instead of one. On the average branch line, the public is served by one two-car train each way each day. The same seating capacity may be obtained by four rail-cars. Service four times as frequent is thus offered at less than half the cost. In the eyes of the public, service four times as frequent is four times as good.

The rail-car not only gives the railways an opportunity to make money on branch-line passenger service that they now offer, but it will enable them to win back a sizable percentage of the traffic that has gone to the motor-bus and the motor-car. On a conservative basis, it is estimated that the railways annually lose $200,000,000 in revenue because of competition by road vehicles. Much of this revenue has been lost because the railroads have been unable to compete with frequent service. A train once or twice a day could not be considered by a traveling public that could obtain motor-buses every few minutes or every hour, or an automobile at command. But the frequency of service which the low-cost rail-car offers will do much to bring back a large share of this business.

It is expected that many interurban electric lines that because of recent conditions in the traction field have been forced to allow their rolling stock, power houses, overhead trolley system, etc., to run down, can recuperate quickly by the purchase of rail-cars of this type.

On steam lines the car's use is not confined to "feeders" and short branch routes, but will be extended to commuting service in the off-peak hours and to regular off-season service on longer lines that cannot afford to operate with steam, except in the tourist months.

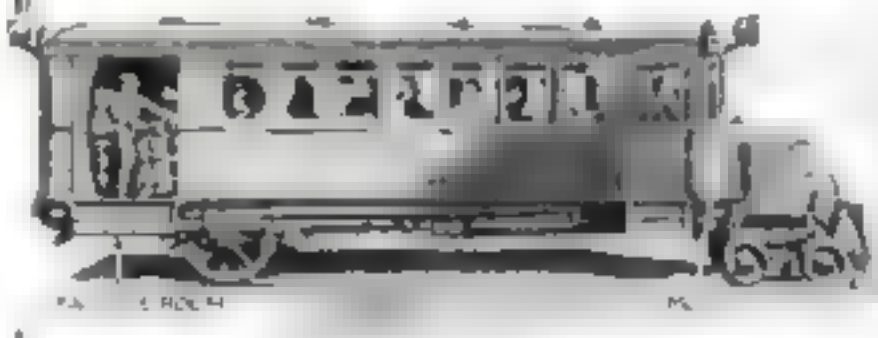
Thirty-Six Persons and Baggage

The rail-car in its latest form has a roomy body for thirty-six passengers, with a baggage compartment in the rear. Passengers enter and leave through doors at the front. The vehicle is propelled by a four-cylinder engine with six-inch stroke, to which is connected a clutch and four-speed transmission. The engine is provided with electric starter and generator Up to this point the machine follows standard truck practice. But the four-speed transmission has combined with it a reverse gear that connects with all four speeds. It has a maximum speed of thirty-five miles an hour, and because of its high gearing a bevel-gear rear axle is employed.

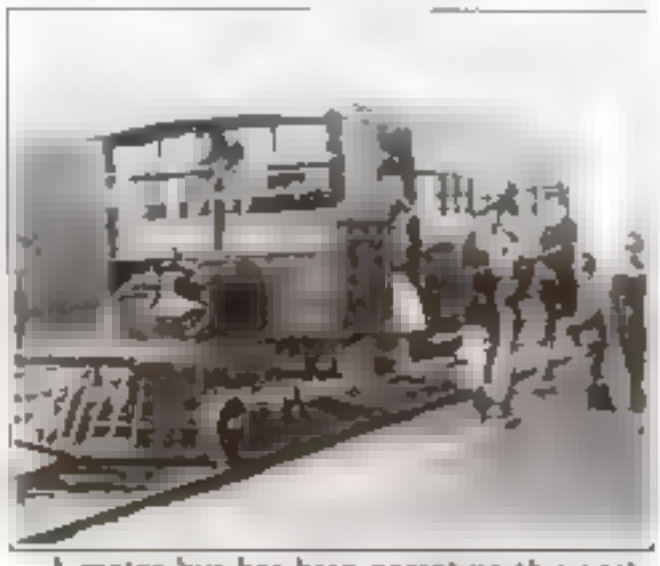
A four-wheel pony-truck supports the car at the front, and a single pair of driving-wheels is used in the rear. Regulation brake-shoes act on all wheels. The driver's compartment looks much like that of a motor-truck. Turning the wheel however, does not steer the car, but applies the brakes. When air-brakes are fitted the brake lever is placed on the steering column, and the wheel then operates the emergency brake.

A New Vision of Railroad Service

MOTOR-BUSES equipped with flanged wheels to enable them to run on rails have been tried successfully on many short roads. Over a sixty-eight-mile stretch through the Hetch-Hetchy Valley of California, buses are transporting passengers and freight. In several parts of New England large railroads have found motor-buses to be the solution of the problem of giving satisfactory commuting service at reduced cost. It is not without reason to believe that the motor-bus may eventually supplant the coal-driven locomotive on the numerous branch lines. The substitution would mean faster and more frequent service, cleaner travel, and lower transportation costs. -The Editor.



One of the motor-cars developed especially for the N.Y., N.H. & H.R.R. for use on their branch lines



A motor-bus has been operating this past summer on the Narragansett Pier branch of the New Haven lines with complete satisfaction to the patrons

What Are Your Chances for Success in Radio?

Read these typical romances of four poor boys who found the route to wealth and fame *via* wireless

By Armstrong Perry

THE sky is the limit in the radio game. The brief annals of wireless are packed with the names of celebrities and men of wealth who were "just ordinary kids" when the radio bug bit them. Their success is explained by the fact that they grew with the industry—and helped it to grow. And the point for you, reader, is that the industry is still growing, and growing at phenomenal speed.

Take, for instance, the dawning opportunities for radio operators on land. Hitherto few operators were needed, except at sea, but now throughout the world nations are being linked up by direct radio communication. In the United States, police and fire departments are beginning to use radio, as are the forestry service, news-distributing agencies, hotels and business houses. The Federal Bureau of Markets is broadcasting daily reports, the Post-Office Department has a chain of stations for directing its mail-planes, commercial companies are establishing services between cities, and railroads are beginning to use radio for general message service. With every year the field will broaden and so will the need for experts in its various phases.

Undoubtedly, however, when the present shipping slump has passed, the sea will again offer the greatest opportunities and the biggest adventures to the new operator. When he has secured his commercial operator's license from the local office of the chief radio inspector, United States Chamber of Commerce, he will doubtless seek through the medium of one of the half dozen great radio and telegraph corporations a job on a cargo boat. However, luck and ability may place a good operator as assistant on a passenger steamship.

Now let's assume that you are the new operator and suppose that you get a berth as the only one on a slow-going freighter. You will discover that the captain begins to rely upon you for the information that will bring his ship safely to port. In the old days his ship had to plow along until a drop in the barometer showed the approach of a storm. But now your prompt

(Concluded on page 30)

William Dubilier

Eighteen years ago a poor schoolboy, interested in radio; to-day one of the wireless industry's greatest engineers, the inventor of a condenser that has made his name known throughout the globe, and has earned him over $1,500,000

FROM East Side schoolboy to millionaire radio engineer in eighteen years—this is the romance of William Dubilier.

It all started when, at the age of fifteen, he happened to pick up a book on wireless, by Marconi. He read three hundred pages at one all-night sitting, went to school next day, and that same night attended a lecture on wireless. The doorkeeper tried to keep him out, but young Dubilier was already the get-there kind. He sat in the front row.

After the lecture was over, he hung around asking questions and making a general nuisance of himself, until, to get rid of him, the lecturer offered to allow him to carry the apparatus back to the hotel. That simple act decided once and for all his future. From then on, as long as the lectures were conducted, Dubilier could be found nightly, first in the audience and later as an assistant to the lecturer, switching lights and arranging the equipment.

So rapidly did he absorb the technique, that a few months later Dubilier was himself delivering lectures for Marconi, filling engagements of lesser importance. He was still in school, but he worked after hours and attended lectures when he was not giving them himself.

His next step was to get a night job with a wireless-telegraph company. It paid neither salary, commission, nor expenses, but he considered the experience ample compensation. After holding the position five years, he won a gold medal at a World's Fair for an exhibition of radiophones.

At twenty-one years of age Dubilier had such a complete mastery of radio equipment that he was summoned by the Russian government to erect its new high-power station. His fame had preceded him. On his arrival in Russia, this boy, who was no older than many youths in high school, was installed in the royal palace, where for a month he was fêted and entertained. The station which he erected at that time was the one that gave the world a jolt a few years later when the Russians, supposedly cut off from communication with Germany by a declaration of war, were found to be keeping in touch with the Berlin government by radio.

It was not Dubilier's fault that his station was used in double-crossing the Allies. Having unintentionally contributed to the wrong side of the world argument, he promptly struck a blow for the other side.

A vital part of every radio transmitter is the condenser. The type in general use at the beginning of the war was the Leyden jar, a glass jar lined with copper. It was fragile, noisy in operation, and gave off quantities of ozone that seriously affected the atmosphere of operating-rooms. The Germans controlled the world's mica supply, so that the Allies could not change to a condenser using that dielectric, instead of glass. One day the Germans awoke to the fact that the Allies were using higher power and longer wave lengths than they had supposed were possible. After the war, it was discovered that among those who had been fighting from behind closed laboratory doors was William Dubilier, whose condenser, constructed on new principles, had helped materially in condensing the German Empire.

Dubilier confesses to thirty-three summers. He can spend the rest of them at Bar Harbor and the winters at Palm Beach, if he wishes—he has the wherewithal. But his favorite resort summer and winter is the little old laboratory on Center Street, New York.

Dubilier secured his earliest training by making himself assistant to the great Marconi during the latter's lecture tour

A few years later the lad from New York's East Side, now a leading radio expert, was entertained by the Czar

report concerning conditions ahead will enable him to dodge the storm area by a change of course. In the same way, it is predicted, radio will eventually supplant magnetic compass, chronometer, and lighthouse. Already it is recognized as indispensable. At harbor entrances automatic radio transmitters are being installed that repeat their exact positions at short intervals. Similarly from the mouths of well-developed harbors radio cables lead incoming vessels to their anchoring grounds.

Again, as a radio operator you may be able to get from ships in your vicinity their position reckonings and so supply your captain with a welcome check against his own computations. Then there are hydrographic reports of submerged wrecks, drifting derelicts, and buoys broken from their moorings. And usually twice a day time signals can be intercepted from the government observatories in several countries.

A Radio Operator's Perquisites

All this is routine; but meanwhile, remember, you are visiting interesting ports in every quarter of the globe without expense and with accommodations as good as those enjoyed by the officers and first-class passengers. When your ship docks, you are at liberty until sailing-time—and your uniform often admits you to circles closed to the man in plain clothes.

And all the time, too, you are making money. Pay for the beginner ranges from sixty-five to seventy-five dollars a month, while experts often draw more than two hundred dollars. This is in addition, of course, to your "room and board" and numerous incidentals, while many an operator finds opportunities to do other remunerative work on board. Thus, some write radio articles for technical journals, others compile trade reports for exporting firms back home, and many study the science of navigation. But the "wise" delve deep into the still unsolved mysteries of their own profession. They know that the big men in radio have all been operators, amateur or professional, who have studied as they worked.

For the big men in radio once knew as little about the subject as you may know now. They realized that the time to begin is now, and the way to begin is to purchase a text-book and get busy. If possible, they would advise you to take a course at a good school, locally or by correspondence, or else to get a radio man to give you instruction. If his terms are high, help organize a class and split expense.

Free instruction, you may not know, is now being given to civilians by the War Department. From corps headquarters powerful transmitters are sending instructions by radio, while other instruction is given by mail. Your questions will be answered. You will have a chance to be inducted into the signal reserve corps, being called to active service usually for the duration of the short summer encampment.

It takes little time to acquire proficiency. In my own case a government license was secured after only four months, and I want to make clear that I was well past the age when men "learn easily."

"But surely," you object, "the profession must be overcrowded by now."

It is true that the current industrial slump has temporarily hit radio operators as it has all other classes, but nevertheless the fact is that in good times or bad there is always employment for the exceptionally good radio operator—and by that I do not mean a radio "wizard", I mean an operator who can send and receive at commercial speed, keep his apparatus in condition and prepared for accidents before they happen, respect the laws governing radio communication, handle customers in a courteous and businesslike fashion, and who in case of service at sea—copies as much "press" as possible for the benefit of passengers and crew, is amiable with officers and associates, and keeps cash accounts and other records in proper shape. Mere technical ability counts for perhaps one third in your success as a radio operator.

But the big prizes in radio go to the operators who stick to the game and get into the executive or engineering branches of the business. Scores of important inventions are still to be perfected and many a practical operator and experimenter now beginning will reap the cash rewards for these achievements. Not one of the celebrities pictured on these pages had a better start than you who read this article. The one brilliant quality I have been able to discover in them is the ability to stick to a thing after the keen edge of enthusiasm had been dulled by the inevitable knocks of drudgery.

They just kept at it and added a bit of knowledge and experience each day, with perhaps a double dose on Sundays. And every little while they have given the universe a jolt by announcing some discovery that was right under our noses all the time.

It is interesting that, of approximately 20,200 licensed radio operators in the United States today 12,400 are licensed amateurs, leaving a total of 7800 who earn their living by operating. Of these 7800 only thirty-two hold commercial first-grade licenses, and only sixty-six of the seventy-eight hundred hold cargo licenses.

Cost of Learning Radio

Tuition for a course which will prepare you to pass the Government examination and receive a commercial operator's license will cost you about fifty dollars.

Books covering the same ground and used by many men for self instruction at home in place of a school course cost from $2.50 up.

A simple receiving-set, composed of a mineral detector, a single phone and wire for aerial and ground can be purchased as low as one dollar.

Better sets, transmitting and receiving, can be built or purchased for from $10 up.

A very liberal allowance for putting a beginner in a position to earn something from radio within a year is $100. This is more than the average operator has spent for his education.

My own expenses, covering the four months from the time I applied for admission to the East Side Y. M. C. A. radio school to the time I received my commercial license were as follows:

Tuition	$40.00
Text book	2.50
Phone	2.25
Note-books	.30
Car-fares	10.00
Notary's fee for executing oath on license	.25
	$55.30

Michal Idvorsky Pupin

whose epochal invention, the Pupin coil, brought him wealth and made long-distance communication possible

PREFERRING citizenship in the land of Washington and Lincoln to a life in Serbia as a general in the army, Michal Pupin sold his schoolbooks and an old watch and started for America.

He landed at Castle Garden at the age of sixteen, with five cents left in his pocket, and spent it for a piece of pie. He licked a newsboy who jeered at his red fez which a fellow immigrant gave him when his own hat blew overboard.

He spent his first three months in America working on a farm and studying English. Then he got work in New York and saved enough money for an education. He entered Columbia University with two hundred dollars in savings. There he won a name for his muscular, as well as his mental, prowess. As a wrestler he won the college championship.

A scholarship took him from Columbia to Cambridge, England. From there he went to Berlin, but Columbia called him back to the professorship of mathematical physics.

His most widely used invention is the Pupin coil. Inserted at intervals in the line, this makes transcontinental telephony as satisfactory as local calls. With the coming of radio telephony, it was found that the Pupinized telephone lines easily took up the human voice, transmitted by radio from Catalina Island in the Pacific and automatically transferred to the land wires, carried it across the continent, and delivered it into another radio transmitter on the Atlantic coast loudly enough to make it audible on board vessels a hundred miles or more at sea.

Pupin, wearing a red fez, got his first glimpse of America from an immigrant ship

He Used His Auto Horn to Get Wireless Message

Roy A. Weagant

Chief engineer of the world's largest radio corporation. His experimentation has led to methods by which static interference is eliminated and weak signals from far-away stations are amplified

WHEN Roy A. Weagant was still in short pants and bare feet, he built a telegraph set and cut in on a local circuit in his home town in Canada.

A discarded hand generator that fell into his clutches peeved him because he had to turn a crank with one hand in order to produce juice to operate his fearful and wonderful electrical devices. It was worse than trying to work a chain pump and keep your mouth under the spout. So he built his own storage battery to serve as a receptacle.

Thereafter, he turned his energies to the construction of a motor. He has not finished it yet, for before he could get all the parts together he went to McGill University to study electrical engineering.

He was mainly dependent upon his own resources. When grub was scarce, he filled up with an extra portion of Hertzian waves, now known as radio waves. He had telegraphed over wires, and had found absorbing interest in these ether oscillations that made it possible to telegraph without any wires at all

After graduation, he went to work. He's been working ever since—working hard; to that alone, or to that and the fact that he always got what he went after, he attributes the success that has made him head of the engineering forces of the largest radio company in the world.

When he landed a job with the Marconi Company—"by going after it," as he says—he soon became absorbed in research work, which led ultimately to feats that have made him famous.

Turning a generator with one hand as he operated the key with the other, Weagant learned his first lessons in electricity

Weagant's outstanding accomplishment is the elimination of static interference. In addition to making it possible to receive signals in spite of atmospheric disturbances, he has also perfected a system of amplification that takes weak signals from distant stations and by means of relays makes them loud enough to be plainly audible

The other day," said Weagant, "I brought in POZ [the transmitting station at Nauen, just outside of Berlin, about five thousand miles away] strong enough to operate a relay. Summer-time worst season for atmospheric disturbances. Sometimes hard to hear signals. Hooked relay to Claxon horn on my ear The horn started off at thirty words a minute. I'll say you could hear the signals!"

Sarnoff Tried Every Job from Office Boy to Manager

Even while he worked at the telegraph key young Sarnoff was mastering the theory of radio from text-books

"PEOPLE think that if a man gets a big job he must be a wonder. It is not so," says David Sarnoff, once office-boy and now general manager of the Radio Corporation of America.

"I came to America from Europe at ten years of age. I did not know a word of English. I started in school and worked when school was over

"In 1905 I got a job with the Commercial Cable Company. Having caught the glamour of radio, six months later I went to the chief engineer of the Marconi Company and asked him if he needed any men. He said: 'We don't need any men, but we need an office-boy at $5.50 a week.' I grabbed the job. I learned how to work the telegraph key and learned the code by studying at home, nights.

"When one of the telegraph operators was transferred to wireless, I got his job. This was the turning point in my life. I knew that the executives then in the office knew little about the practical end of radio. The real radio men were all down in the research department, or at the shore stations or on the ships. I believed that if I could get out of the office atmosphere and into the practical end of the business I could come back and have something the other men did not possess.

"In 1907 the company opened the Siasconset station and I applied for a job as radio operator My friends in the executive offices told me that if I took the job I should be a sixty-dollar-a-month man all my life. I took the job, and in two years became a competent commercial operator. There was an engine, a generator, and a storage battery emergency outfit there. I did the dirty work because I wanted the experience. Nobody quarreled with me about that. I was only eighteen at the time.

"By 1912 our company had four hundred ships and fifty coastal stations. Men were needed as operators, and I was soon appointed an inspector, to supervise their work and our equipment. After that I was made successively chief inspector, assistant to the chief engineer, assistant traffic manager, contract manager, manager of the commercial department, and finally general manager.

"There is no country that offers such opportunities as America. I have traveled extensively and I know. And there is no profession that offers better opportunities than radio."

David Sarnoff

After his climb from office boy to general manager of a great wireless company, he declares that any boy with a definite object and persistence can win out

Every-Day Wonders

Easy Questions About Familiar Things—Can You Answer Them?

1. Why does alcohol cool the body when used externally, and seem to warm the body when taken internally?
2. Account for the appearance of frost on window-panes in winter.
3. What causes clouds to form? How high up are rain clouds?
4. Why should water reservoirs be without roofs?
5. How does a fire-extinguisher put out a fire?

IN each issue Popular Science Monthly asks ten questions that every reader should be able to answer. Follow them carefully and you will acquire fascinating knowledge about the secrets of science affecting our daily lives. See answers below.

6. Why is a burn from steam at 212° F more severe than a burn from boiling water at the same temperature?
7. Why does water freeze first in pipes on the top floors of houses?
8. Would the householder who kept a wet cloth over his gas-meter be able to get more gas for his money?
9. What causes the black smudge to form on the ceiling above an oil or gas flame that is not burning properly?
10. Why does blue cloth look nearly black in gaslight?

Five Minutes a Day Will Make You Master of These Fundamental Facts of Science

Alcoholic Effects

1. When used externally, alcohol makes the body feel cool for the same reason that water does. In each case the liquid evaporates: and since heat is necessary to change a liquid into a gas, the water or the alcohol takes the heat from the body, to which it is closest

When used internally, alcohol affects the nerves that control the small blood-vessels in the skin in such a way that they are dilated. This results in a rush of the blood to the surface of the body, which causes a warm feeling. On a warm day it is the heat of the atmosphere expanding the blood-vessels near the surface that gives us the warm feeling. But with alcohol as the dilating agent, what is actually happening is that the body is being unduly cooled, because so much blood is being brought to the surface of the body. Because of this fact a drunken man may freeze to death despite his first deceptive feeling of warmth.

Frost on the Pane

2. The air you exhale on a cold day cools to the lower temperature of the outer air Warm air has a greater capacity for holding water vapor than cold air. Having been very warm in the body—the body temperature is 98.6° F.—your breath was able to hold large amounts of water vapor, but as it cools it must release the excess water, which therefore condenses into a cloud of vapor

Now think of the window-pane of a warm room in winter. On one side there is air that holds a great capacity for moisture, because it is warm. On the other is the cold air that cools the glass through the inside surface. Inside, the people are living and the moisture that they exhale and the perspiration from their bodies are being absorbed by the warm air As this moisture-laden air comes in contact with the cold window-pane, it loses its capacity for holding moisture and condenses, forming frost.

Height of Clouds

3. As currents of air are heated by the earth's surface, they rise and in rising expand, due to the gradually lessening pressure in higher altitudes. In expanding, the air is cooled and condensed into minute drops of moisture, a large number of which form a cloud. Rain clouds are seldom higher than a mile.

Why are Reservoirs Roofless?

4. To allow the oxygen of the air and the ultra-violet rays of the sun to mingle with the water and purify it. The rougher the water as it is agitated by the wind, the more oxygen will be absorbed. This is the reason why the water in many purification systems is sprayed into the air as a fine mist.

How are Fires Put Out?

5. In either one of two ways. The more common is by wetting the burning surface to reduce its temperature below that of the temperature of combustion The second method makes use of heavy gases that form a blanket over the fire, preventing the entrance of oxygen, without which a fire cannot burn.

Burns from Steam

6. It requires over five times as much heat to turn icewater to boiling water and then to steam as to heat the entire mass of liquid from freezing to 212°—the temperature at which water boils. This excess heat that goes into the steam must come out again when the steam strikes a surface and is cooled. It is the presence of this extra amount of heat—known in physics as the "heat of vaporization"—that makes a burn from steam more severe than one from boiling water.

Freezing of Pipes

7. Most substances shrink in volume as they are cooled. Water is no exception to the rule until it reaches 4° C Then it ceases to shrink and begins to expand as it cools to 3°, 2°, 1°, 0° C., when it begins to freeze. As ice it occupies more space than it does as water. Now if water behaved normally, lakes and all bodies of water would freeze from the bottom up, killing the fish. But water near the freezing-point floats to the top because it is lighter and freezes there.

The Gas-Meter

8. As the wet cloth dried, the gas-meter and its contents would grow colder. Now, most things, including gases, expand when heated and contract when cooled. And when the gas in the meter contracts, more gas flows in to fill the space. This space is inside of a bellows arrangement which turns the dial indicator through a series of gears as it discharges the gas through the pipes into the room where the gas is being used. Therefore, if the bellows holds more gas, it will discharge its contents and register the same amount of gas on the dial as when the gas was warmer

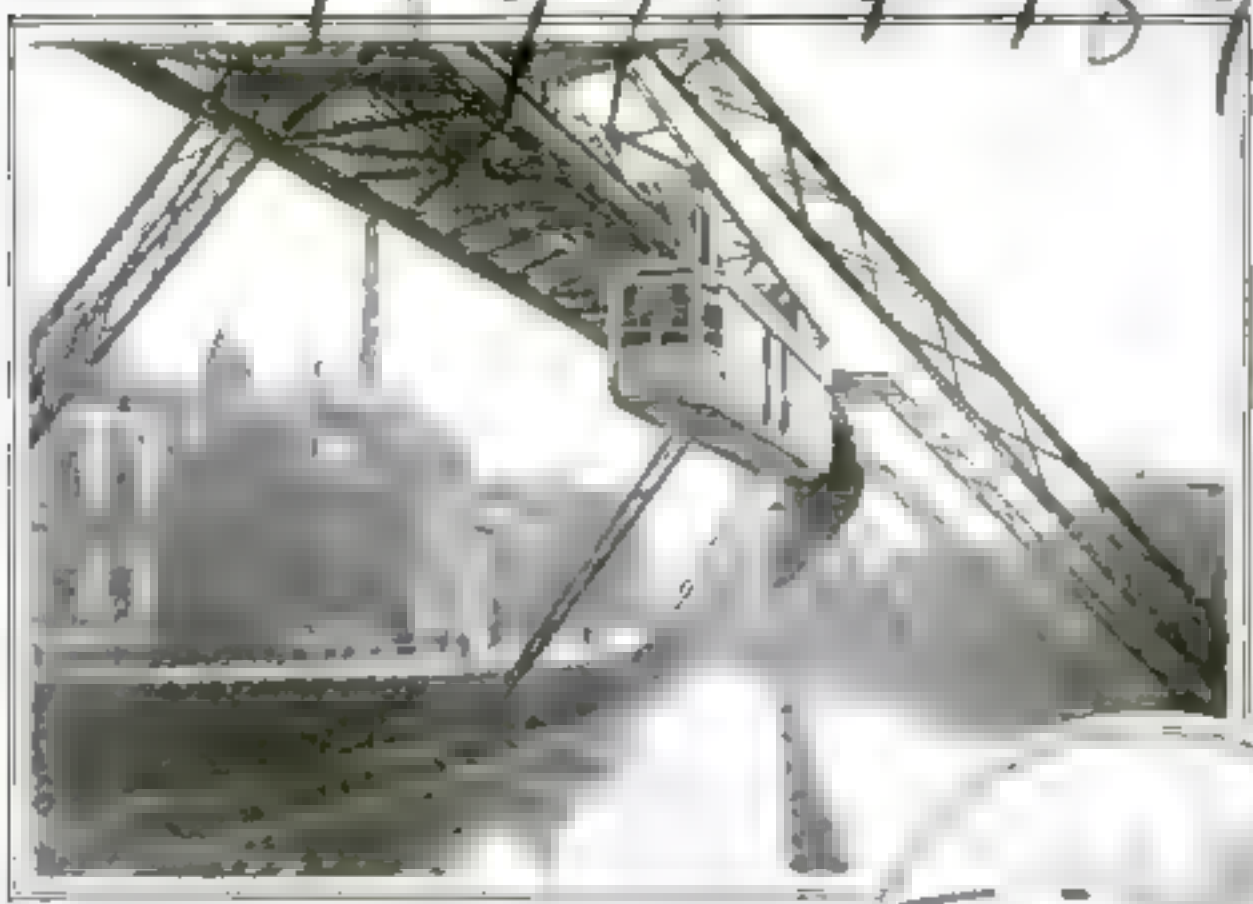
When Lamps Smoke

9. When a gaslight is burning properly, it is being supplied with enough air to burn the fuel completely, which may be gas or oil or kerosene. The light is usually produced by small particles of carbon coming from the fuel, which have been heated till they glow But if the air supply is insufficient, a great deal of this carbon will leave the lamp-chimney or gas-tip unburned. This exodus of minute particles of carbon forms the smoke and the smudge that accompany the improperly burning lamp.

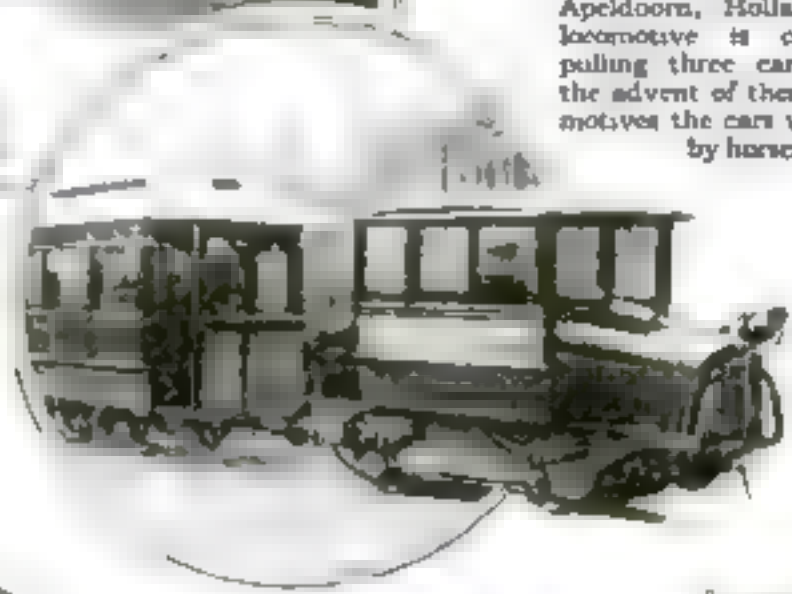
Color of Cloth

10. When a beam of white light, such as we get from the sun, shines on blue cloth, the latter will absorb all the colors that go to make up "white," except the blue, which it will reflect to our eye. The cloth then appears blue to us. In the same way, red cloth looks red when the light striking it contains rays that it reflects. Green cloth will reflect green rays, and absorb all others. Now, gaslight is usually deficient in certain colors, especially in the blues and purples. That is why gaslight is yellow And so, because there is very little blue from the gaslight that the blue cloth can reflect, it sends practically no rays to our eyes. The blue cloth absorbs most of the other colors. Since practically no light comes to our eyes, the blue cloth appears black, which is merely due to the absence of light.

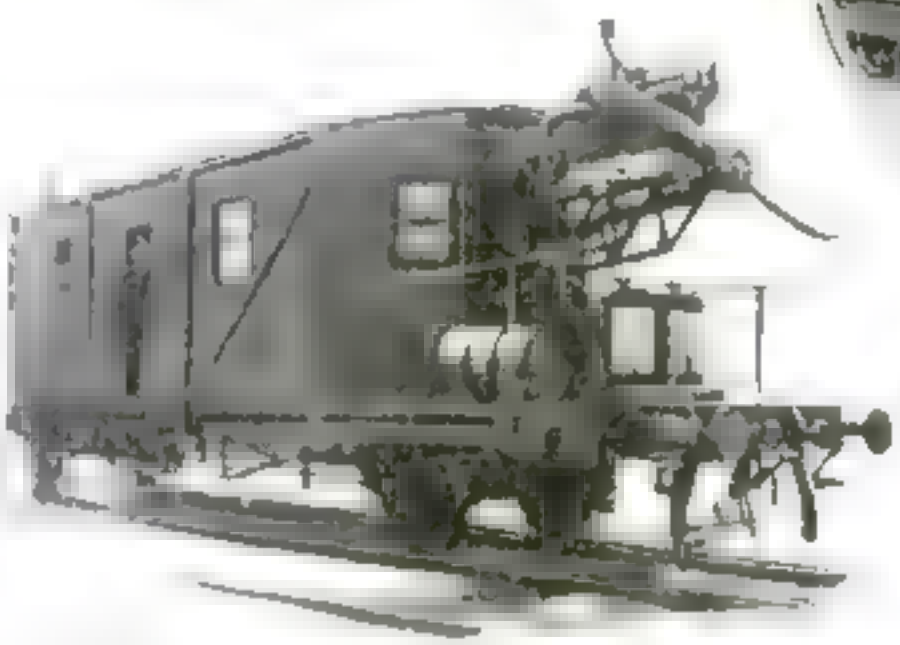
Railways of Odd Design from All Parts of the World



The famous suspended railroad of Elberfeld. By making use of the space above a canal, the elevated road is made possible without obstruction of street traffic

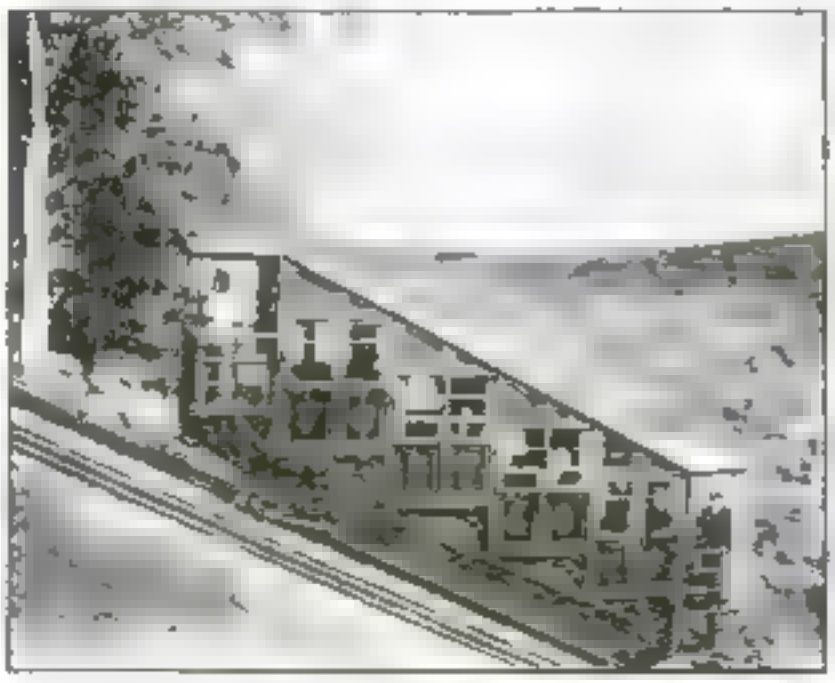


Autos now furnish the motive power for the trolleys in Apeldoorn, Holland. Each locomotive is capable of pulling three cars. Before the advent of these gas locomotives the cars were drawn by horses



Two airplane engines and propellers, one on each end of this car, drives it at a speed of two hundred miles an hour. The car runs on a regular scheduled time between Berlin and Hamburg, Germany

This unique torpedo-shaped hanging trolley that does service in Burbank, California, has a seating capacity for sixteen persons. It is driven by a propeller at one end. Such construction is practical only in California's climate



The Malberg railway at Ems is built to conform to the steep slope of the mountainside. The passenger compartment is built in a series of steps so that the seats are always upright

Only intrepid Alpine mountain-climbers ascend the Wetterhorn in any other manner than by this cable railway. The peak of this mountain is over twelve thousand feet high

Getting Thrills out of Made-to-Order Collisions

EVEN if you don't own a flivver, you can have the pleasure of running into people. You can experience the sensation of having your automobile struck by another one, or by two or three at a time.

The sport is staged in an enclosure paved with sheet steel and with an overhead covering of heavy steel netting. There are parked within this well-fenced lot about twenty-five small cars that look like big tubs set on four wheels. The visitor takes his seat in this round flivver, and grips the steering-wheel firmly. Next he puts his foot on a big button. The effect of this pressure is to start things going in every direction. Each car has its own trolley, the wheel of which connects with the netting which forms the roof of the pen. As the metal strands are very uneven, and the car has no guide for its wheels, the motor which gets the current, causes the machine to go plunging around the place like a bucking broncho. The motive power comes from the overhead screen, which is charged with electricity and which can be turned on or off at will by the electrician at the switch.

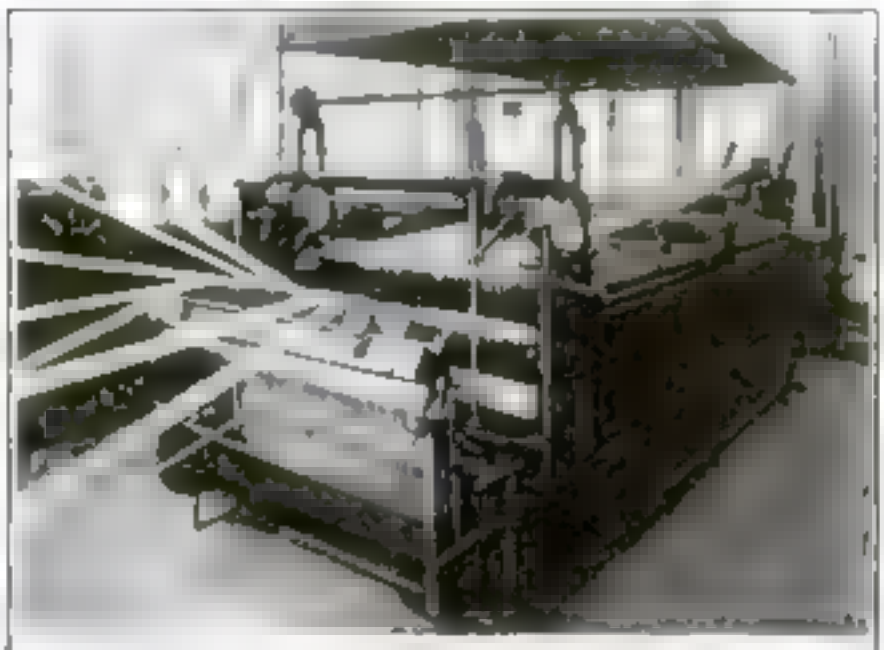
Cars driven from overhead trolleys supply thrills by their eccentric actions. Tempered steel springs on the base of the cars act as buffers

The effects might be serious, were it not that around the bases of the cars are projecting circles of high-tempered steel springs. When the cars collide, the shocks are easily broken by the metal absorbers. The amateur chauffeur has all the excitement without the broken bones that often accompany adventures on the road.

In the course of a few trips, one may become proficient as a pilot and even steer a strictly straight course. The worst performers in the arena are the skilled chauffeurs, who apply the principle of steering as they understand it and miss the idea. The wheel turns in the reverse fashion of the automobile steering device, therefore the better driver on the road one happens to be, the more awkward he is under these abnormal conditions.

How Heatless Tires Are Made by New Process

INTERNAL heat, one of the chief causes of tire destruction, is said to be eliminated by the invention of a tire-manufacturing process that embodies seventy-three improvements. Each cord or rope in these tires passed through a machine called the beamer, which takes the place of the more familiar calender in tire manufacture and which coats each strand with an even layer of live rubber. During manufacture the strands sometimes adhere so that before the cord is applied it is necessary to go over the surface of the strands with a steel comb and separate the strands. With this composition, it is impossible for the friction of one strand on another to cause heat.



The beamer, showing the braided rope cord each strand passing through a rubber bath, being coated with rubber

The cords are continuous around the bead wire. After the cord belts have been rubberized they are [illegible] into strips [illegible] tire with [illegible]

[illegible] tire. As each rope is surrounded by rubber, it is free from the rest during the process of manufacture, and can twist and turn and adjust itself individually when the tire is shaped by the air process. At the same time, a patented device keeps each rope in the finished tire at exactly the same tension, so that every one carries its share of the load.

Because of the elimination of internal friction, it is said to be possible to build this tire with only two plies of cords, instead of the customary seven or eight layers of fabric. Long life is expected from the tire as a result of its great flexibility.

The inside lining is of rubber—a new feature, which the manufacturers say could not be successful if internal heat were generated, since the inner tube would [illegible] this rubber lining. No soapstone dust is [illegible] between the tube [illegible] the for lubrication as the tube

After the rubberized cords are formed into the tire, the strands are combed so that each cord is carefully separated from its neighbor

The cords come to this machine in long belts with a cushion of rubber along each side. The belts are wound diagonally around the bead wire guides

A section of the completed tire-carcass with one of the two layers of cords removed to show the assembly of rubber-covered cords

Hand Loom Produces Big Cravat Output

WITH a simple hand loom, crude in its design, but capable of work that compares with the finest, William Bennett, a disabled sailor, who was formerly a practical scientist and an optician of ability, has been turning out large quantities of silk ties in his improvised room in the Dugout, a well-known New York institution for ex-service men.

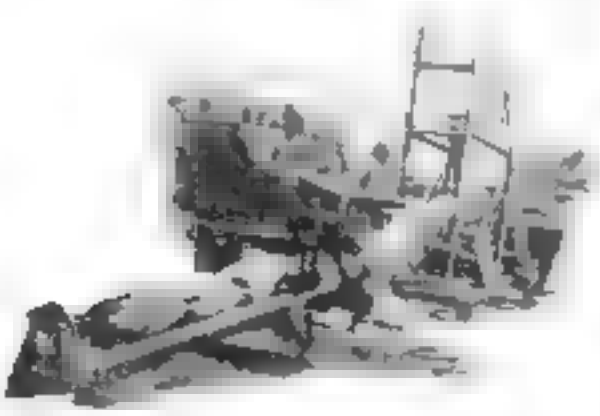
Bennett has become so proficient with this loom of his own invention that he is able to weave ten to twelve silk neckties or belts a day. The handiwork is so fine that his product brings the highest prices.

Conveyor Handles One Hundred Tons of Flour an Hour

PORTABLE ship-loading units for freight in bags consisting of an electrically driven conveyor which can be moved anywhere about the dock and a tower by which the conveyor can be raised to any height required by the different classes of ships will greatly expedite the storage of cargo.

This new unit discharges the bags into the hold through automatic chutes. Thus the whole operation is made as nearly automatic as possible, and few stevedores are necessary.

By means of this conveyor ordinary bag flour is easily handled at the rate of one hundred tons an hour, and by speeding up, an exceptionally efficient crew has



Conveyors carry the bags from wharf to ship's hold at the rate of one hundred tons an hour

loaded as much as two hundred tons an hour. In this way great savings were effected, not only in wages, but by cutting down the length of time a vessel must remain in dock to take on cargo. Breakage and spoilage are practically eliminated, while the cost of loading flour is reduced from $1.25 to 65 cents a ton.

Space in New York's Canyons in the Panic that Never Happens

WHAT would happen on one block of New York's crowded streets if all the workers in the buildings were suddenly transferred to the street? Where Pine Street runs east from Broadway in New York stands a thirty-six-story building [illegible] one side of the entire block. The average height of the buildings opposite is twenty-five stories. The total number who go and come to work on Pine Street is sixteen thousand.

The average man requires about two and a quarter square feet of standing space. If everybody in these buildings tried to stand in the street at once, the crowd would be packed nine tiers deep and 124 men would be left over. The street would be packed solidly with people up to the level of the windows on the fifth floor.

Boxes Fall Thirty Feet Unhurt

TO expedite the handling of heavy cases of canned meat between the packing floor and the shipping platforms an American concern has installed a shaft down which the cases can be dropped over thirty feet without injury.

No cushions or spring shock-absorbers are used. The air in the shaft is employed as a cushion. The shaft is made slightly larger than the dimensions of the boxes, and is arranged so that when the cases are dropped it is hermetically sealed at the top and the bottom. The falling box compresses the air in front of it and creates a vacuum behind it strong enough to drop it at the bottom without injury. This method has proved three times as fast as an elevator.

For Drawing Wedged Keys in Transmission Shafts

HOW to remove tightly wedged keys in transmission shafts without tedious hammering and without danger of scoring or otherwise damaging the shaft surface has long been a problem. The tension of the shaft, however, and [illegible] wedge the key tighter and tighter [illegible] in some cases it practically [illegible] with the shaft.

Instead of hammering painfully [illegible] thin edge of the key in its slot, a German now uses his recently invented key-remover, which, because of its sureness and simplicity and safety, is likely to become a famous tool.

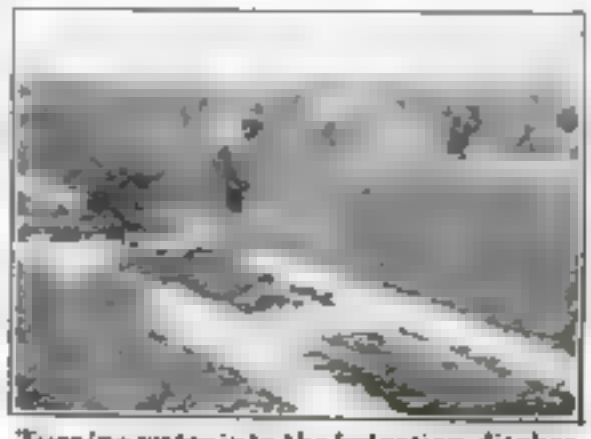
The device may be placed over the shaft at any place; it does not have to be slipped over the end—an advantage in the case of a long shaft with several pulleys. When it is fastened to the shaft and attached to the key, the turning of its screw brings a powerful leverage to bear on the key. The upper of the two rollers shown in the illustration comes down to the shaft surface like the other and the key is extracted. Rollers are used to protect the shaft. The continued turning of the screw until the upper roller reaches the surface of the shaft removes nearly every wedge.

However, if the key should resist this powerful leverage, it does not mean that the remover has not functioned. Either the key is pulled or the pulley is pushed—one or the other. And, of course, when the pulley is shoved past the key, it is no longer difficult to extract the wedge.

Raising Figs Instead of Thistles

IRRIGATION and the tractor turned a California desert that had grown nothing but cactus and thistles for centuries into the greatest fig-growing region in the world.

The hot sun and the dry air are ideal for this fruit, and the desert soil proved surprisingly fertile when irrigation was applied.



Turning water into the irrigation ditches in a plot of young fig-trees

A secondary screen, made in sections and rotated in front of the main screen, makes motion-pictures appear stereoscopic, that is, they stand out in relief from the background

Adding Perspective to the Motion-Picture

AN interesting experiment has been carried out on motion-pictures by a French scientist in which he has obtained some remarkable effects of depth without the employment of accessories beyond a unique screen. In his researches he discovered accidentally that if two positive views taken from the same negative and identical in every way are placed one on the other and viewed by transmitted light, the human eye distinguishes between the two views and produces an effect of perspective.

Further experimentation with this phenomenon brought out several ways in which the idea could be applied to motion-pictures. One method makes use of a rotating screen as in the illustration. This rotating screen, with the segments removed, is placed directly in front of the regular screen. By reason of the persistence of human vision, the spectator is made to see certain parts of the picture in more than one plane and the result is as if the picture itself had stereoscopic qualities.

The principal objection to this scheme, and one that would prevent its general use, is the fact that the audience must sit directly in front of the screen and at a certain distance from it, otherwise the distortion becomes so great that the effect of depth is lost. It is expected that further work along these lines will produce a screen or series of screens that will give the desired result without limiting the seating arrangement of the auditorium.

ALTHOUGH a falling barometer will invariably give warning of bad weather, the fall does not take place far enough in advance of the rain to be of much value. However, you can tell if the glass will rise or fall hours before the movement occurs.

If it is a mercury barometer, look at the top of the column. If level, the glass will be steady for hours. If the top of the mercury is concave, a fall is coming; if convex, a rise may be expected.

The information can be secured from an aneroid by watching the movements of the point of the indicator when the case is tapped lightly with the finger-nail. A jerk backward indicates a fall; forward, a rise.

Auto Crane for Barge Canals

THIS French automobile crane may give a hint of one way in which the United States may make its barge canals profitable. It has been cheap, if slow, to haul by water, but unloading has been so expensive that few business men use the canals, particularly at way stations, where modern handling equipment was altogether absent. This crane goes where it is needed, and will handle cargo as rapidly as any hoisting device of its type. The crane revolves in a complete circle on its base, so that patterns may be taken from the barges and loaded directly into trucks.

The engine supplies power to both the wheels and the crane. In operation the wheels are locked with the emergency brake and the transmission gears thrown into neutral. The gear-box is unusually large, and contains an additional set of gears attached to shafts operating the hoisting windlass and the turning mechanism of the crane.

The driver sits facing the rear. His right hand handles the lever controlling the turn of the crane, his left operates the hoisting engine. The pony brake-pedal is under his right foot, and his left is on the regular accelerator.

In cranes of this type the cargo is raised and lowered by the tackles. The boom is not moved except to adjust it to the proper height or reach. This is accomplished by a special gear-shift that throws a gear on the hoisting engine into mesh. The boom is then raised or lowered to the proper position by the regular controls. An engine supplies the power.

A traveling crane mounted on a truck makes for mechanical efficiency in unloading barges along French canals. A fifteen-horsepower engine supplies power for crane and truck

Elevators that Run on a Curve

ELEVATORS usually travel perpendicularly, but those that connect the East Boston tunnel with the State Street station run on a curve. Owing to the narrowness of the street at that point it was impossible to build the station directly over the platform in the tunnel, a variance of six and a half feet being necessary.

One of Boston's curiosities is an elevator that rises on a curved line. Hard-wood guide-shoes keep it level

The cars run on hard-wood guide-rails heavily backed by steel I-beams that are attached to the iron structure. There are guide-shoes at all corners that accommodate themselves to the curvature of the rails. The car floors are level at all times and the passengers are not aware of the peculiar path followed by the cars.

Each car—there are four of them—will hold fifty people and it will travel at a speed of two hundred and fifty feet a minute. The tunnel station is fifty-seven feet below the street level; thus the six and a half foot curve is a very gradual one.

Two somewhat similar elevators have been installed in the famous Eiffel Tower, Paris. The legs of the tower are curved and the elevators travel on curved rails a distance of four hundred and twenty feet, the height of the second platform.

THE German alloy "elektron" contains 90 per cent magnesium by weight, but may be melted without danger of igniting in air as magnesium will. The metal has a tensile strength of from seven to nine tons a square inch, which is increased from eleven to fourteen tons by rolling or stamping. Elektron is proof against gasoline, acid free oils, grease and alkalis.

Polarized Light Reveals Original Work of Artists

WITH a tube that looks more like a telescope than anything else, M. Lambert, a Paris scientist, accomplishes what seem like miracles with the dingy works of old painters. He has taken paintings that have become darkened with the dust of centuries and with his apparatus has made them appear to the eye as though recently finished. Even the details that seem to have been lost are restored to all their original brilliancy.

A highly illuminated painting viewed through a Nicol's prism is disclosed in all its original coloring

The painting to be examined is illuminated by a powerful incandescent lamp or an arc enclosed in a lantern. The light passes through a condensing lens and then through a correcting lens, which makes the rays parallel before they pass through a tube containing a Nicol's prism, which polarizes them. After the light has passed through the polarizer, it is refracted by a diverging lens so as entirely to cover the painting to be examined.

A painting may be said to consist of two parts, the layer of pigment and the coat of varnish that covers and protects it. The varnish turns dark with age and the light reflected from its surface interferes greatly with the light reflected by the pigments of the painting underneath the varnish.

When a painting, illuminated by polarized light from the apparatus described, is viewed through a single tube containing a Nicol's prism or through a binocular containing such prisms, it becomes possible, by turning the prism or prisms to the proper angle, to deflect the rays reflected from the varnish, permitting only the unpolarized rays reflected by the pigments of the painting to reach the eye or eyes.

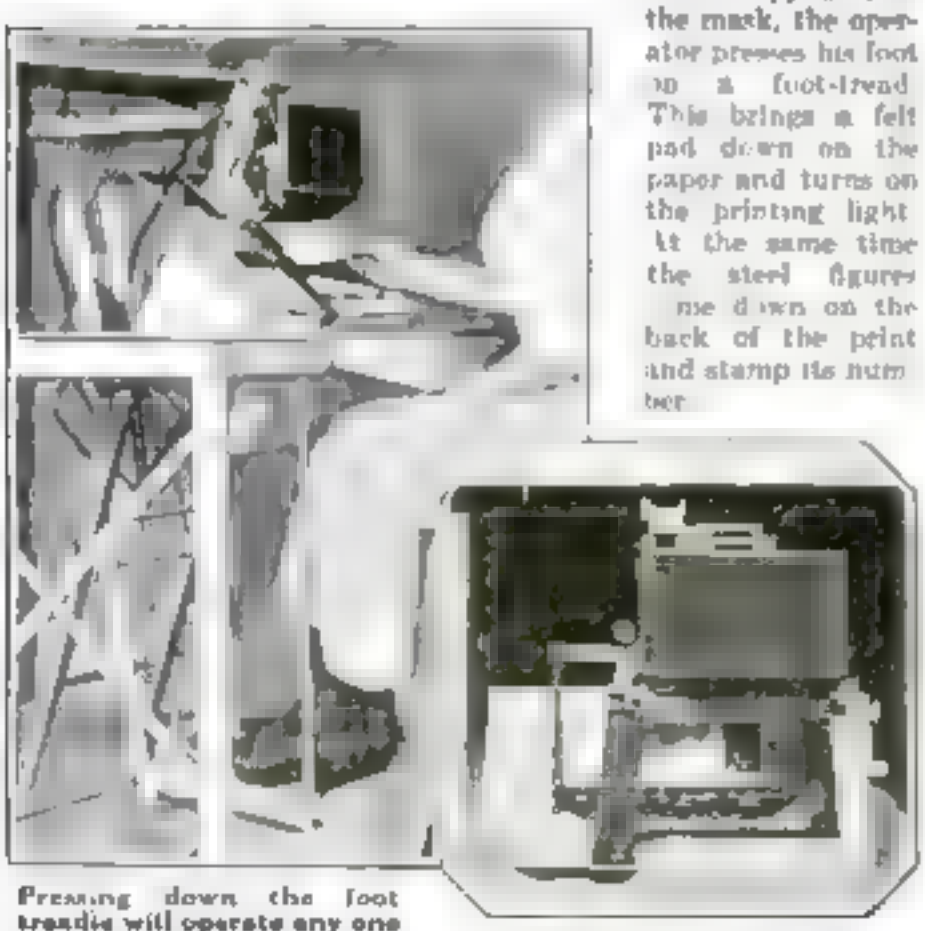
In an exhibition given before the French Academy of Science, an old picture of a bouquet of flowers was marvelously revivified. The painting was old and obliterated but under polarized light the flowers were seen to be roses and honeysuckle, resting in a dark-green glass bowl of water.

Print 1500 Photographs an Hour

THE professional photographer who prints negatives by the thousand needs a machine that will do the work quickly. The machine illustrated below has a capacity of fifteen hundred photographs in one hour. It prints from single films, uncut rolls, or glass plates. Shelves above the operating table contain stacks of negatives, while pockets at the right are intended for the various size sheets of photographic paper.

James Flynn, of New York, the inventor, has also devised a one-piece adjustable mask, which merely requires the turning of a thumbscrew to fit it to any width of border or any size print. There is also an automatic stamping device that changes the number with each print and stamps it upon the back as the print is being exposed to the light. The type is of steel and is inked by a ribbon.

The light for printing is provided by four gas-filled incandescent bulbs of one hundred-watt capacity. These bulbs are arranged to assure even illumination. The machine has a "double-break" contact switch that operates the amber or red pilot light and the printing light. When the paper has been slipped into the mask, the operator presses his foot on a foot-tread. This brings a felt pad down on the paper and turns on the printing light. At the same time the steel figures come down on the back of the print and stamp its number.



Pressing down the foot treadle will operate any one of the switches and at the same time it will number the prints

A thumbscrew is all that is necessary to adjust this mask to any size negatives

Floors, walls, and stairway are all of plate-glass. This is how a movie director obtained the illusion of fairy-land

A Plate-Glass Fairy-Land

A VISION of fairy-land was reproduced in the movies by a scene taken in a setting built entirely of plate-glass. Glass of five-eighths-inch thickness was used. Working from drawings, a crew of carpenters proceeded to completely cover a big stage and much of the surrounding studio space, building a floor. At one end of this platform glassworkers simultaneously installed a solid plate-glass stairway.

As soon as the platform was in readiness, other glaziers proceeded to cover the entire wooden floor with large slabs of more plate-glass. Plate-glass walls twenty feet in height were set in place along two sides of this "room," the stairway forming a third side, and the remaining side serving as a gateway for the cameras.

Beneath the transparent stairway a complicated system of lighting was installed in such a way as to provide a striking picture of flickering lights playing on the waters beneath the glass steps. Where the steps debouched on to the glass floor two wide shallow pools were constructed. Rising from the surface of these pools were eight octagonal glass pillars, each bearing upon its apex a large basket of blown-glass fruit over which the water from the enclosed fountains played.

It required two days and nights to film this episode and the whole vision will flash on the screen in approximately three minutes.

Giant Outdoor Reflectors for Photographing Movies

DID you ever wonder how the movies were able to take such sharp, clear photographs in the shade? Here is one of the secrets. A gigantic, flat reflector is being used to give the proper high-lights on the face of Corinne Griffith, who does not appear at all embarrassed by the juvenile audience at her love scene.

With these screens the cameraman can control the lighting effects out of doors as perfectly as in the studio. They are part of the regular equipment of some film-producing companies for pictures taken under the shade of trees, which are usually the despair of every amateur photographer.

The reflectors are made of galvanized tin to keep the light from becoming too bright. The reflection from a plate-glass mirror, like sunlight itself, might produce halation effects and would certainly destroy the illusion of shade when the picture was exhibited.

Ukuleles of Steel Will Withstand Hard Usage

AMONG the latest innovations are steel mandolins and banjos.

The instruments are comparatively inexpensive, since they are pressed out of steel, are as indestructible as anything can be, and the manufacturer claims they tone is excellent.

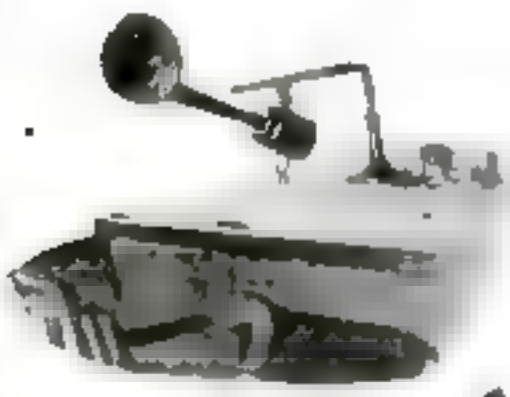
The instruments are light in weight, and should make a useful gift to young children learning to play, who would be almost certain to damage a mandolin of the usual fragile construction.

Bungalows Made from Discarded Street-Cars

THE housing shortage in Washington, D. C., during the past few years has produced some queer living accommodations. Here we have a family who considered themselves fortunate to get a couple of old horse-cars to serve as the nucleus of their bungalow.

The abundance of windows practically turns the entire dwelling into a sun parlor. It is said that many houses of this type have been constructed along the banks of the Potomac.

Besides saving lumber, the use of street-cars for side walls reduces the cost of building the remainder of the house. Numerous windows and complicated framing become unnecessary. It is reported that the cars were sold for their value as junk.



No More Telephone Headbands for Train-Despatchers

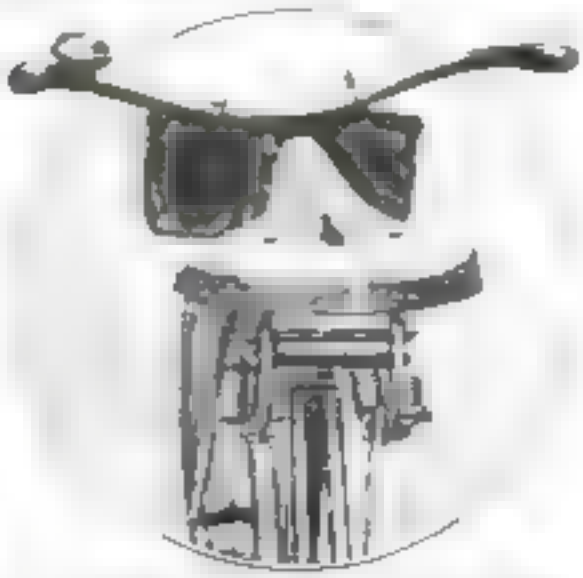
SINCE telephonic train despatching has been in use, many of the men have suffered from ear trouble, some of it due to the pressure of the receivers and some due to static and other noises constantly occurring on the line.

The invention of a loudspeaker for train-despatchers will do away with all the drawbacks of the head receiver. This loudspeaker is composed of an audion amplifier, an electrodynamic loudspeaking receiver, and a voice-strength regulator. The amplifier allows the most distant station to be heard with clearness, while the voice-strength regulator tones down the voice from the nearer stations to any required volume.

Bumps Help Drive This Bicycle

M. JEANNET when he is bicycling in the environs of Paris, looks for the roughest roads. The bumpier they are, the easier it is for him to pedal, for each bump that rocks his saddle also causes a rod to drive a ratchet gear attached to the rear wheel.

A tilting quadrant on springs is the rear support of the saddle, which rests in front on a lever bar whose fulcrum is beneath the handle-bars. With this arrangement the rider feels only a slight shock on the most uneven roads.



A tilting quadrant on springs supports this bicycle saddle at the back, resting on a lever bar in front

Holds Lamp-Globes Safely and Insures Quick Removal

HAVING two arms ending in broad, curved shoes which hold the lamp-globe by pressing against it outwardly from the inside, this new lamp holder is said to be absolutely safe. Turning one knurled screw spreads both these arms apart until the globe is clamped between them and the rim of the fixture.

Contact is established all the way around the globe, whereas in the usual three- or four-point holder the few points of contact make the hanging of the globe uncertain, and unequal stresses set up by tightening one screw more than another often crack the globe when it becomes expanded by heat. This trouble is avoided with the new holder, which also permits quick removal by one man.

The Hangar that May Never Have a Tenant

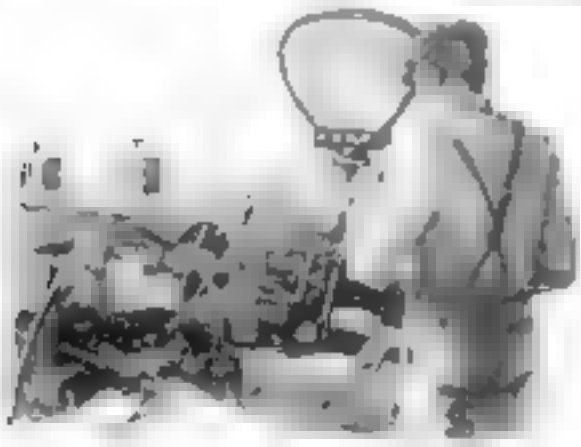
THE huge hangar built at Lakewood New Jersey, to house the ill-fated ZR-2 may never have a tenant Whether or not the catastrophe of America's British-built dirigible will have a dampening effect on the further development of lighter-than-air craft depends on the governmental investigation of the accident. In the meantime the second ship of the same class, which was to be constructed in this country, remains unfinished

This photograph was taken as the finishing touches were being placed on the hangar. The shed has a height of 200 feet a width of 350 feet, and a length of 807 feet

Each of the four doors of the hangar weighs 251 tons and is opened and closed by two 20-horsepower electric motors. All of the windows in the walls and roof are supplied with special amber-colored glass to prevent the entrance of ultra violet light rays that would deteriorate the fabric of the envelope.

Several hundred feet away from the hangar is the hydrogen gas plant where the gas for inflating the big dirigible was to have been generated

Whatever the findings of the board of inquiry as to the structural weaknesses that caused the disaster, it seems to be the belief of military and aero experts that since the dirigible has a definite place in wartime, its development must be continued, but perhaps along slightly different lines than heretofore.



This machine runs special cutting tests on brass rods to determine uniformity of material

Taking the Guesswork Out of Brass-Rod Cutting

TO insure that his brass rod shall be absolutely homogeneous and possess uniform cutting qualities, one founder runs a cutting test on every lot before it is poured.

Since cutting qualities of brass depend upon the accuracy with which the mixture of copper and zinc is maintained in the making, a small rod from every "mix" is cut in the special machine shown, and the mixture is changed until the indicator shows the desired cutting qualities.

Such careful testing proves its value in screw-machine work, where uniform toughness in the rod allows continuous high-speed output and reduces tool breakage to the minimum. The resistance of the test pieces is recorded on the dial of the dynamometer on a special lathe.

California Weed Causes Seventy Punctures a Day

SEVENTY punctures in one tire in a single day is the unenviable record of a California motorist who recently traveled through that section of the Golden State where the puncture plant is prolific and productive. Introduced as a stowaway in burs in the fleeces of imported sheep, the plant has become well established in certain sections of California. It is responsible for 50 per cent of the bicycle and approximately 40 per cent of the automobile punctures that occur in these states.

Uncle Sam has been conducting a countrywide weed survey and has ascertained definitely that the puncture weed is spreading rapidly. The bur splits at maturity into five sections, each equipped with a pair of bayonet-like spines about one quarter of an inch in length. These sections are scattered about on the ground in such a manner that one of the spines always points upward ready to puncture any inflated tire that passes over it.

Puncture weed has five sharp prongs, any one of which will penetrate automobile tires

This Portable Lamp-Guard Is Strong but Light

VARIOUS new features are embodied in this type of portable lamp. For one thing, its strength of construction will appeal.

A casing completely surrounds the lamp nearly to the base of the filament and from this casing radiate flat guard strips around the lamp

A special aluminum alloy is used for this metal, so that strength does not mean weight. A bayonet type socket is The wooden handle is easily re and when taken off, it facilitates of the socket There are no passages through which to thread t

Milk Aerator and Cooler for Small Farmer

THE milk aerator and cooler invented by Cyrus W. MacKenzie, of Waverley, Indiana, combines extreme simplicity in design, operation, and effectiveness in results. The inventor was a dairyman on a small scale, and found that cooling milk by dipping it up and pouring it back into the can aerated the milk and drove out the animal heat well enough, but took too much time.

The idea occurred to him that it would be quicker to force air into the bottom with a pump and let it cool the milk as it bubbled to the surface. His chief difficulty was to devise a pump that would be perfectly sanitary and easy to wash.

His invention is essentially a simple pump that sucks in air on the upstroke, compressing it, and forcing it through the milk on the downstroke. It gives the small farmer the use of one of the improvements usually reserved for the large dairy, and as for ease in operation—the picture shows the simplicity of the machine, such that even a child could handle it.

Electric Iron Turned Upside Down Forms Stove

HOTELKEEPERS will [illegible] German who invented [illegible] for travelers an evil genius. In the first place, the pan cheats the house [illegible] out of profits by [illegible] and uses up current. The novelty [illegible] the fact that it also [illegible] be turned upside down, the handle [illegible] apart as a rest, and a meal cooked on it. It comes packed in a handsome case. The whole weighs only about four pounds.

Endless Elevator Loads Truck in One Minute

BACK up your truck to the coal, sand, or gravel, pull a lever, and this truck-loading machine starts doing the work of four men.

The elevator buckets, arranged on an endless chain, fill themselves at the feeding end and automatically discharge into a hopper at the top of the machine as shown in the picture below.

The self-feeding devices (operating like two large human hands) dig into the stock pile alternately, and pull in the material against the line of rotating buckets in such a way that each bucket receives a full load.

The machine can be equipped with either a four-cylinder gasoline engine or an electric motor. When it is properly operated, this loader will handle more than a cubic yard of material a minute. It is unnecessary to go into fuller detail about this efficient machine. The illustration gives a clear idea of its construction and method of loading and discharge.

Two self-feeding fingers on this loader dig into the pile at the rate of a yard a minute

Testing the Breath of Bananas in Transit

IT seems that the popular banana continues to breathe after it is harvested, its respiration being greatest at night. The carbon dioxide expended by bananas in cargoes on ships, trains, and fruit storage houses must be constantly carried away by ventilating devices, for the sake of the banana's flavor and its preservation.

The device shown in the illustration on a refrigerating car, tests the inside air. Samples of the air are collected through rubber tubing, and the reactions on lime-water noted.

Graphite Sorted by Primitive Method in Ceylon

THESE Singhalese girls work so cheaply that no machine can compete with them, and about the only way to start a strike would be to insist that they do their work seated in chairs, for they prefer to work in the squatting position which would be impossible to a European. The group is engaged in sorting graphite.

Graphite occurs in isolated scales and veins embedded in the older crystalline rocks, chiefly gneiss, schist, and crystalline limestone, although the Ceylon deposits are found in granulite. The rock must be broken into small pieces, examined for indications of graphite, and the culls thrown aside, much as slate is picked off of coal in a breaker.

The cheapness of native labor is shown by the fact that hammers are used to fracture the lumps instead of breakers, and that the sorting is done by scattering the lumps over the ground instead of placing them on a moving belt.

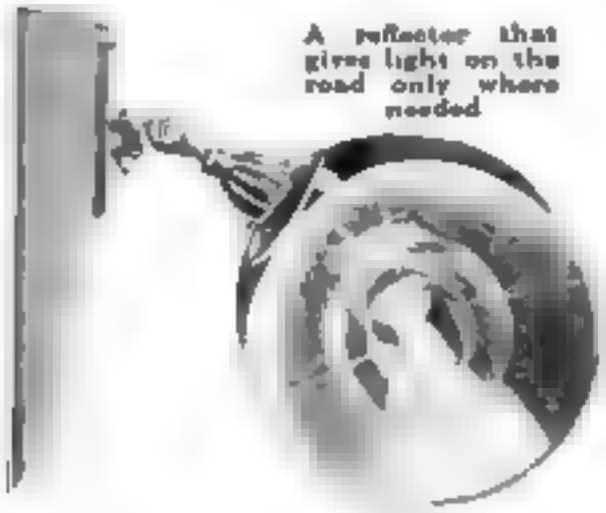
Graphite is found all over the world, but the greatest quantity comes from the island of Ceylon.

Importing City Lighting for the Country Road

EXPERTS declare that a large percentage of night automobile accidents can still be traced to the blinding glare of headlights, in spite of the improved headlight reflectors of many types that are being adopted. To eliminate mishaps from this cause, an experimental installation of highway lighting has been put up on Paradise Road, near Swampscott, Massachusetts. On entering this stretch the motorist turns off his main headlights, since the road is lighted as brightly as Fifth Avenue.

If the experiment is a success, it is expected that the cost of such lighting improvements will be apportioned as part of the expense of highway work.

The light unit consists of a nest of reflectors, one within the other. Two of



A reflector that gives light on the road only where needed

these direct the light toward the roadway at an angle of ten degrees below the horizontal. An opening just below the top of the lamp also allows some light to be directly on the road immediately beneath the installation. The bracket holding the reflector is adjustable, so that the fixture can be mounted on poles close to the road, or on locations some distance away.

Machine Measures Leather Area

ILLUSTRATED below is a machine used to measure the area of hides. It will make allowance for the uneven edges of the skin, and will even subtract the area of a hole in the center of the hide. As the skin is drawn through the machine, the friction turns a series of wheels that will not move except when they are in contact with the leather.

The rims of the wheels are of known

© Kadel & Herbert

The hide is fed into this machine and numerous fingers follow the contour, measuring the surface

width and circumference, and it is comparatively easy to translate automatically into terms of surface area. Hides are sold by the square foot, and a machine like this is used to determine the amount to be paid.

Fire-Truck Helps Out in Water Famine

A THUNDERSTORM that burned out the motors of the pumping station at Clintonville, Wisconsin, totally cut off the city's water supply. In the emergency a fire-truck supplied water service until the repairs could be made.

The truck, which was equipped with a five-hundred-gallon pump, was located near the city well. A double line of hose was run to the pipe lines inside the pumping station, and although the water tower which can be seen in the background of the illustration is 164 feet above the pumping station, the fire-truck was able to fill it.

Gas-Bombs Reduce Rioters to Choking and Tears

A handful of the tear bombs that effectively dispersed the mobs

"TEAR-GAS" bombs with which various police departments are being equipped for use against rioters and unruly mobs, are the invention of Major Stephen De La Noy, of the United States Army. This is an application of a war device to peacetime uses.

During the war shells filled with lachrymatory gas were "sent over" by the hundred to make the enemy blind with weeping and distressed with coughing, choking, and sneezing.

Tear-gas bombs will not only check the advance of a wild mob and stop rioting, but will be invaluable in "smoking out" dangerous criminals barricaded in houses. With a puff of tear-gas near him, the worst of desperadoes is no longer dangerous. One little bomb may reduce the most hardened criminal to a weeping, cowering wreck.

Two hundred members of the Philadelphia police force were the first to experiment with lachrymatory gas. These stalwarts were organized into a rioting gang and were dared to rush past a given point, within throwing distance of five A. E. F. veterans. None of the cops got past the point, excepting those who rolled on in paroxysms of sobbing.

There are no after effects from a dose of lachrymatory gas, but during its half hour of efficacy, it chokes and nauseates as well as produces floods of weeping.

The Smallest Ornamental Tree in the World

JAPANESE gardeners prune, starve, and potbind trees to dwarf them. Conifers are best liked for this development, as the hard woods are not so tractable.

The method of stunting is said to be secret, the heritage of certain families for centuries, but two explanations are offered. One, from Japan, is that the tree seed is placed in a half orange, its roots being clipped off when they bore through, the skin finally being varnished and the bound roots placed in soil.

An American arboricultural suggests that the trees are propagated in high altitudes whose rarefied air produces stunted growth; strong pruning, lean soil, and pot cultivation also being resorted to.

Japan offers many varieties of dwarfs, but the popular kinds of these tiny trees are: *bonsai*, perfect miniatures; *kengai*, with long branches; *nosaeki*, with "weeping" branches; *sikki*, with geometrically arranged twigs, and *wagari*, with exposed roots.

A stunted tree produced by the methods of Japan

Completely Automatic Car-Coupler

SIXTEEN years ago John Genin, of St. Albans, Vermont, set to work to make an automatic railroad coupler that would make it unnecessary for the brakemen to crawl under a car to connect the air and steam lines. Recently his invention was perfected and tested by the Canadian National Railroad, which endorsed it very highly.

The coupler is an adjustable plate so constructed that a car equipped with an automatic coupler can couple up to one that still has the old-fashioned mechanism. It makes the connection air-brake, steam, and whistle lines all automatic and does not require the attention of any one during the process.

Horizontal Forge Press Economizes Space

ONE of the features of this horizontal forge press is that it economizes in overhead space, which is sometimes a necessity and always an advantage in small works.

The soft metal in molds or matrices gets the full force of 10,000 tons upon it and the forge quickly turns out axles and similar products. Only the matrix need be changed for a variation in the forging.

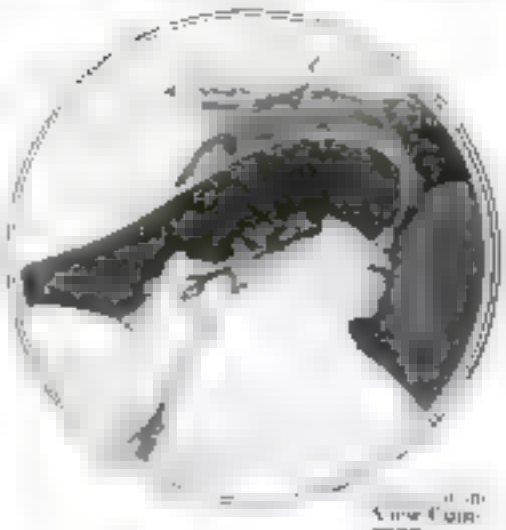
This machine is proving a great success in Germany, where, it is said, novices are operating it. Many German mechanics were killed in the war and simple machinery is in demand.

Inspecting High-Tension Pole Lines

AN inspector of high-tension wires must be able to walk over railroad-ties and other uneven places without lowering his eyes from the wires overhead. An error in judgment on his part, the neglect to notice a rotting cross-arm or a broken insulator, might involve the failure of this high tension transmission line, with a temporary ebullition of fireworks and subsequent darkness throughout the city.

There are some peculiar requirements for his work. He must be able to determine the condition of telegraph-poles at a glance, and have them replaced before they blow down in a heavy storm. He must be able to gage the rate of growth of various kinds of trees so that he can have them trimmed before they interfere with the wires.

Most difficult of all, perhaps, a wire inspector must remember every minor defect along miles of line, to avoid reporting the same breakage twice. His route is arranged so that the whole line is inspected at least once a week. Cracked insulators and warped cross-arms give the most trouble, as any electrician with telegraph wire experience will tell you.



A New Way to Bob the Hair

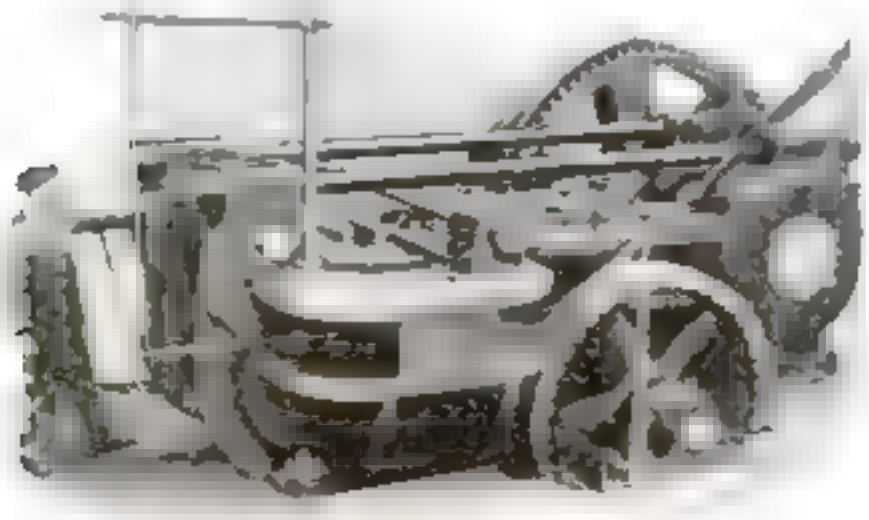
IT isn't the easiest thing in the world to cut hair so that it will hang evenly all the way round, but with the little guide shown above the hair is trimmed to the proper length. The device is an improvement over the traditional soup-bowl used by our grandmothers for this operation.

The guide is made of heavy cardboard and can be cut out at home. It is good also for the mother whose little daughter dislikes the trip to the barber's chair. Older girls who want to bob their own hair can do it in the same way, but to paraphrase *Punch's* famous advice, the wisest counsel for those about to bob the hair is—Don't.

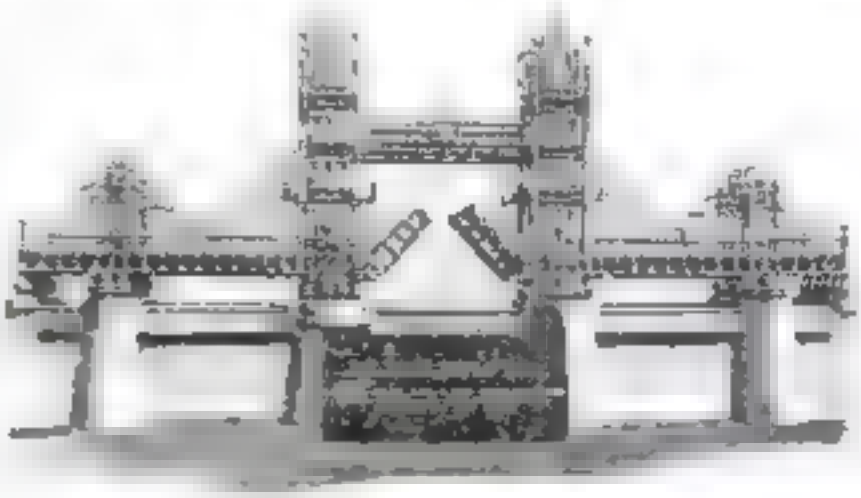
The Tower Bridge in Valve Fittings

THIS window-display model of the Tower Bridge in London was made of valves and fittings, with only a postcard view of the original for a guide. In it there are 15,505 pieces taken from regular stock, comprising 230 different kinds of elbows, tees, crosses, nipples, and valves, and 16,251 joints were used to make up the fittings. It is worthy of note that not one left-handed thread was used in the entire structure.

The model is approximately 19 feet long by 11 wide by 4 feet high. The drawbridge can be raised and lowered, and the colored lights on the pipe model signal traffic exactly as do the warning lights operated on Tower Bridge.



The operation of this horizontal forge press is so simple that a mere novice is able to run it



Not one left-handed thread was used in this model of London's Tower Bridge

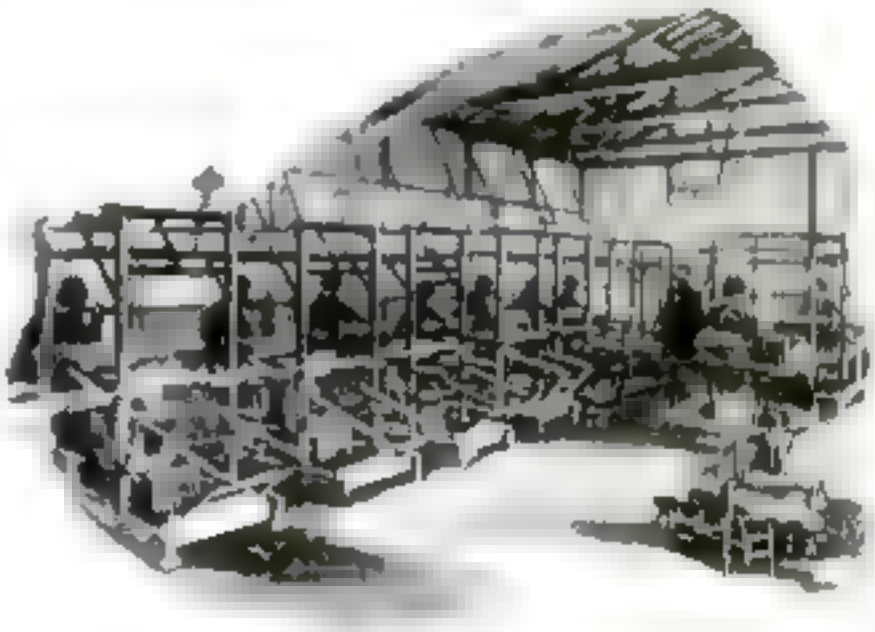
1900 1

Primitive Methods Are Still Used by the Japanese in the Manufacture of Silk

The boards in this illustration are covered by [illegible] and [illegible] Each [illegible] lays from two hundred to five hundred eggs in the [illegible]

A corner in the silk weaving room These girls weave beautiful designs with the primitive foot power looms, yet the high degree of dexterity demanded of the workers calls for a wage equal to about one fifth of what the similar task would bring in America

The completed cocoons are placed in a basin of water and then unwound on to reels Close watch must be kept for uneven strands and strands partially eaten through



This picture shows the primitive machinery that Japan is content to use in its manufacture of silk. As a rule, the weaving is carried on entirely by foot treadles

At frequent intervals during the life of the silkworm the beds on which they are placed must be changed. The man at the right is placing a bed of worms back on the storage shelf

Feeding mulberry leaves to the silkworms. The worms take about a year to hatch and after they emerge their appetites are unbounded. During their life they eat their own weight in mulberry leaves

When a car of grain is to be sampled, this testing-rod is thrust down through the load. When withdrawn, the compartments are filled with specimens from different levels

Grading Wheat in Carload Lots

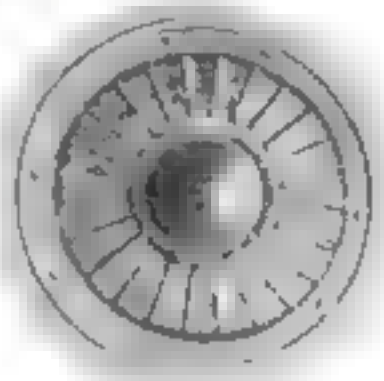
HUNDREDS of tests by the Federal Bureau of Markets prove that there is a vital relation between the grade of wheat and the yield of quality flour that can be milled from the grain, but it has been difficult to the point of impossibility to locate a small pocket of low-grade wheat hidden somewhere in the contents of a loaded freight-car. This trouble has been overcome by the invention of a sampling rod that enables wheat to be taken from every portion of a carload in a short time, and by running a test of samples taken from fifty different points, the investigator can get a reliable idea of the average grade of wheat in the car.

The grain probe has ten compartments, independent of each other, which are opened and closed by turning the handle after the probe has been plunged into the grain. Five probes are made and the samples placed on the cloth. Dirty or faulty wheat loaded in any portion of the car can be easily discovered. If none is found, the cloth is folded from the four corners, which thoroughly mixes the samples, and the grade of wheat is then determined. Thus the Bureau of Markets can determine the quality of the entire carload by one test. Farmers get a better price for clean wheat, and where these tests are in use, they find it profitable to store the grain carefully.

The Tire Is Inside the Rim

BASED on an entirely new principle, this patented automobile wheel carries its pneumatic tire inside the rim, where it cannot be punctured or cut. As the illustration shows, the new wheel consists of an outer tire of solid rubber on a flexible metal rim supported by a small, fully inflated pneumatic tire attached to a

The inflated inner tube serves as a cushion for the outer rim



A steel disk covers the wheel keeping dirt and oil from the inner tube

second rim bolted to the hub. In service the whole wheel is protected by a metal cover that guards the tire inside even against dust and sunlight. The inflated tire "rides" in fork-shaped grooves that connect it with the outer rim.

The inventors claim that this arrangement combines the wearing qualities of the solid rubber tire with the resilience and comfort of the pneumatic. It was developed to unity tracks over rough roads that cut pneumatic tires. Creeping has been eliminated, and as the inner tire never comes into contact with the road, it will hold its air for a long time, perhaps almost indefinitely. The outer rim, made of steel, is sufficiently flexible to keep from being permanently deformed or dented by the shocks of driving over rough roads. The weight of the car is borne by the forks, and is supported by the inflated tire.

Roller Coaster Built by Children

The track is uneven and the car insecure, but the boys who built this roller coaster get more fun from it than if it were perfect

THREE of the cleverest boys living on the East Side of New York City conceived the idea of making their own roller coaster from odds and ends found in back lots. The enterprise fitted into the imaginations of other youngsters and soon boxes and boards were collected in sufficient quantity to construct the coaster.

As completed, the coaster is two hundred feet long and makes down the natural slope of a hill. A packing-case mounted on roller-skate wheels serves as the car. The track is not smooth, but that only adds to the exhilaration of the slide.

Keeps Airplane Engine from Freezing

This simple heater keeps the airplane engine from freezing by circulating warm water through it

COLD weather no longer has any terrors for the airplane owner whose hangar cannot be heated in winter. An airplane engine-heater, tested by the Army Air Service, that maintains a constant circulation of hot water for twenty-four hours will keep the radiator from freezing.

The stove consists of a twenty-four-inch vertical coil of three-quarter-inch copper pipe surrounded by a sheet iron jacket, a burner in the base, two fire-screens, a fuel tank, gasoline feed-pipe and connections and inlet and outlet water-pipes from the coil to the top and bottom of the radiator. The circulation is thermosiphonic. The burners require a pint of gasoline an hour. Care should be taken in lighting the stove, and the fire-screens above the burner must be kept clean, for soot deposited at this point is liable to cause trouble.

In starting the stove, the feed-pipe is filled with gasoline, the tank put on, and the main burner valve slowly opened. The "gas" then fills a cup. When nearly full, the burner is closed, the fuel in the cup lighted and allowed to burn out. Then the main valve is again opened, at the same time lighting the burner with a match. The door of the heater is tightly closed and the valve at the bottom of the supply pipe is then put at a quarter turn. The stove will burn without attention until the fuel is exhausted.

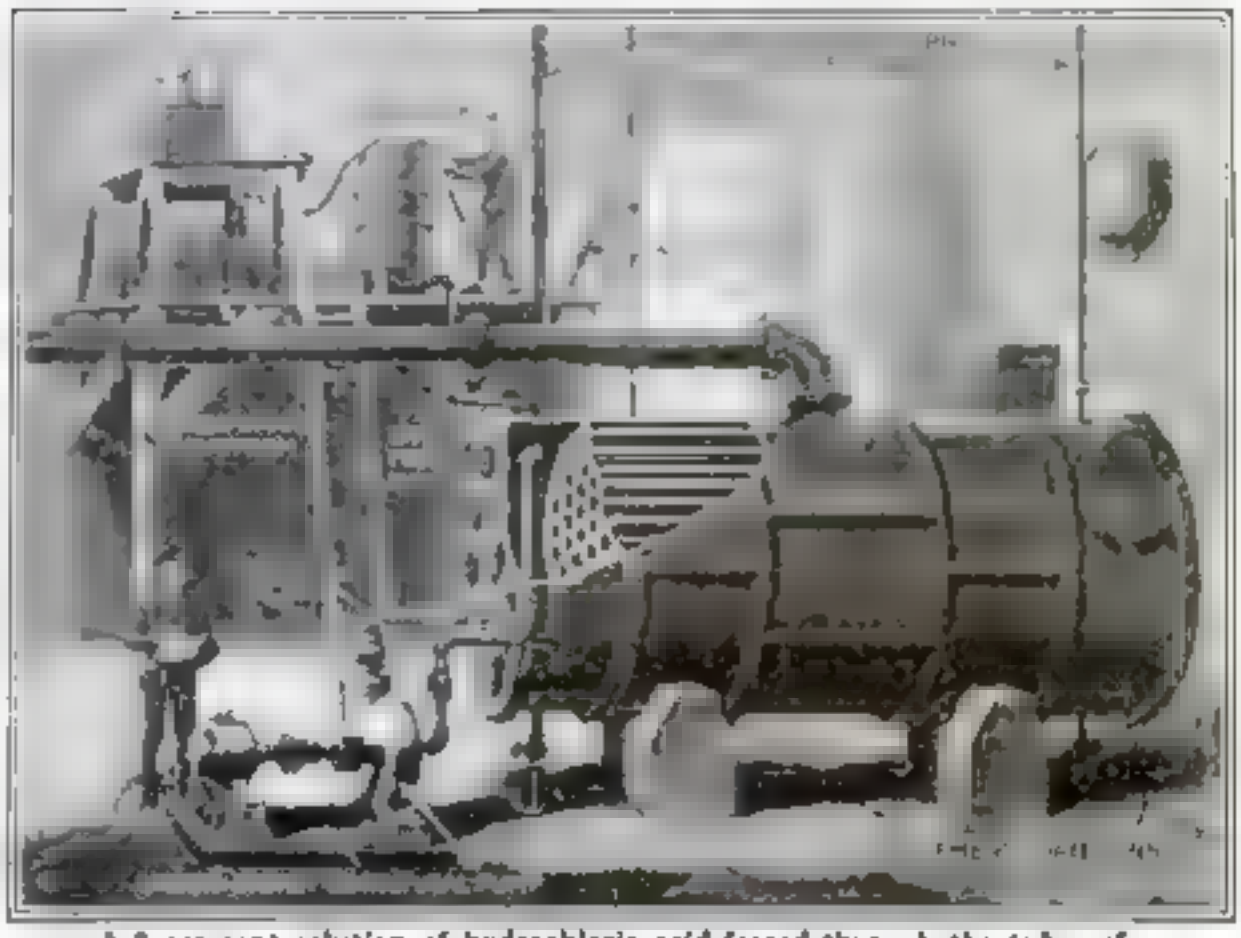
It is not uncommon for glassblowers to drink from twenty-five to thirty quarts of water in the course of a day's work, but history mentions a baby of three who used to drink two pailfuls of water a day. She grew up, apparently quite healthy, gradually increasing her quota to four pails.

Mutilating Plants to Make Them Grow

FRUIT or flowers are worth more than wood. English botanists cut rings in the bark of trees in order to [illegible]

Deliberate mutilation of plants increases their growth and productivity

wood, for this would kill the branch. The cut is then bandaged. The result is that the sap cannot be absorbed by the bark, but passes on to the buds. At the Ashton Experimental Station in Bristol, England, it has been proved that in skilful hands this treatment makes the bark thinner, and greatly increases the size of the leaves and the productivity of the tree.



A 3 per cent solution of hydrochloric acid forced through the tubes of surface condensers effectively loosens the boiler scale and makes a comparatively inexpensive job of cleaning the boilers

Hydrochloric Acid Removes Boiler Scale

A POWER-DRIVEN mechanical cutter is usually employed to remove scale from the tubes of surface condensers. It is admittedly not the best method, for in addition to the expense of the operation, tubes are liable to be broken, but engineers hesitate to use a dilute solution of hydrochloric acid, in spite of the [illegible] advantages of this process, because the [illegible] the possible action of the acid on the metal parts of the condenser and tube packing.

In the opinion of Norman [illegible] Hardy, chief mechanical engineer of the Arizona Copper Company, this danger may be overcome. He has used acid for cleaning condenser tubes for two years with excellent results by the method illustrated in the illustration. He calculates the saving effected in cleaning a 7800 square foot condenser amounts to $893.41 over mechanical methods.

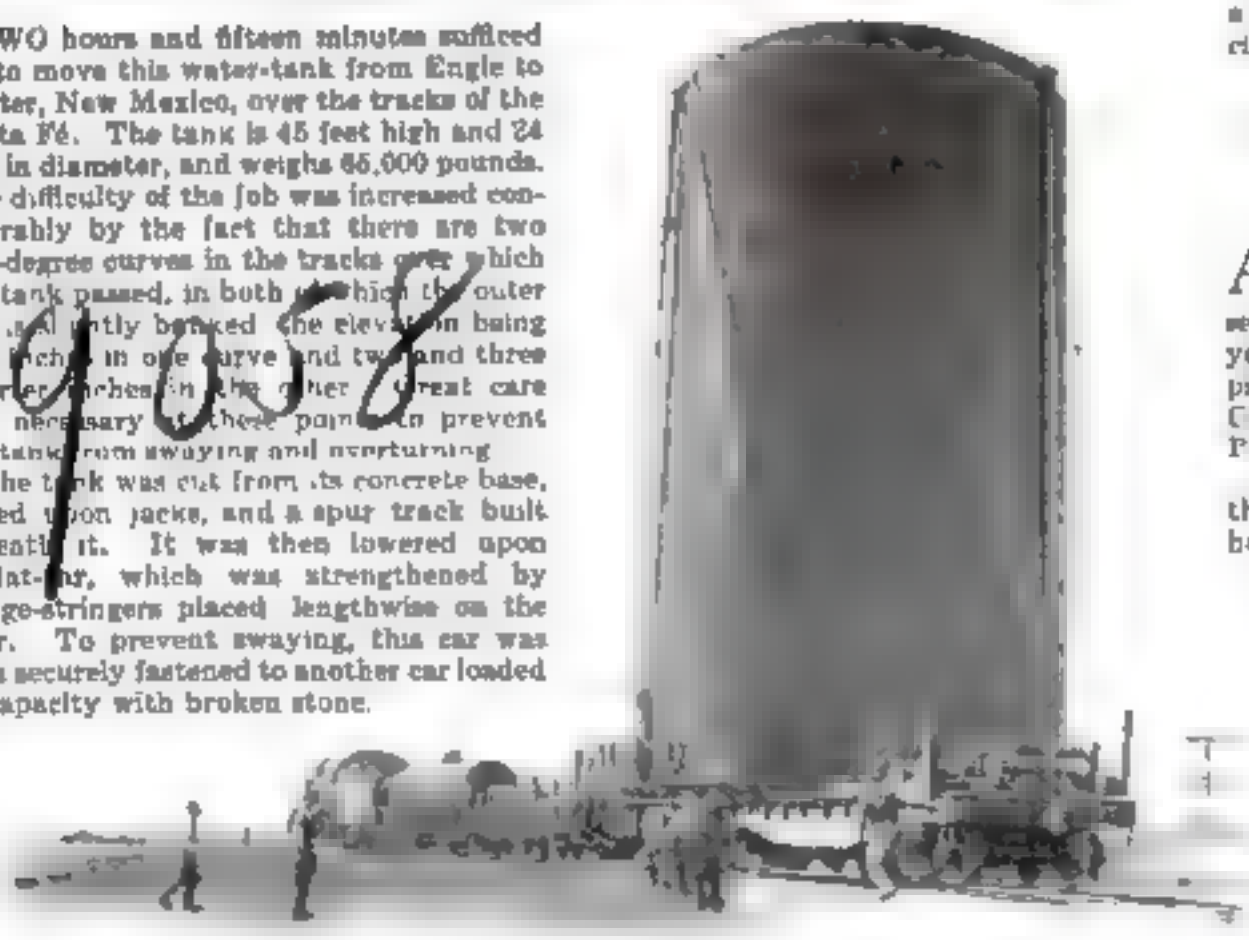
A 3 per cent solution is pumped through the condenser from four to five hours, after which the loosened scale is washed off with a wire brush and a hose. To protect the metal parts, the water-boxes, heads, and tube sheet are first cleaned mechanically and then painted with two coats of roofing cement. Cover plates and gaskets are next fastened over the water inlet and outlet, with capscrews tapped into the water-box. The heads are then replaced and the apparatus connected up as indicated above.

A two-inch brass centrifugal pump with a directly connected motor drive is used to circulate the solution.

This Oil-Tank Was Moved Nine Miles

TWO hours and fifteen minutes sufficed to move this water-tank from Engle to Cutter, New Mexico, over the tracks of the Santa Fé. The tank is 45 feet high and 24 feet in diameter, and weighs 65,000 pounds. The difficulty of the job was increased considerably by the fact that there are two one-degree curves in the tracks over which the tank passed, in both of which the outer rail was slightly banked, the elevation being two inches in one curve and two and three quarter inches in the other. Great care was necessary at these points to prevent the tank from swaying and overturning.

The tank was cut from its concrete base, raised upon jacks, and a spur track built beneath it. It was then lowered upon a flat-car, which was strengthened by bridge-stringers placed lengthwise on the floor. To prevent swaying, this car was then securely fastened to another car loaded to capacity with broken stone.



This twenty-four-foot oil-tank, forty-five feet in height, was hauled nine miles over a railroad track of ordinary width at the rate of four miles an hour

Caruso Candle Will Burn in 6921

A CANDLE weighing a thousand pounds, that will burn twenty-four hours every second day in November for five thousand years, is a memorial to Caruso that will be presented by Italian orphans in New York City to the Church of the Madonna di Pompei, Naples.

Caruso was born in Naples on November the second. The candle will burn 120,000 hours consecutively, or for almost fourteen years. The figure of Christ will be modeled in wax on the candle's base, and the name of every orphan contributor will be imprinted on the stem. The wax was contributed by the candle-makers, Antonio Asello and Brothers, of New York.

This memorial is a grateful acknowledgment of the singer's contribution of ten thousand dollars a year toward the support of the orphan asylum in New York City.

The First Large Suspension Bridge to Be Built since 1909

In building a suspension bridge, a temporary pathway is first strung across for the movement of workmen and the wire-stringing machine

With one end of the wire anchored, this traveling wheel carries one loop across to the other shore and returns with another

SPANNING Rondout Creek, a tributary of the Hudson River at Kingston, New York, is the first large suspension bridge to be erected in twelve years. The last one of any consequence was the Manhattan Bridge over the East River, New York City, which was built in 1909.

The Kingston bridge is made up of two towers, 168 and 185 feet high respectively, from which cables 1185 feet long are hung. The length of the roadway is 1145 feet, with a clearance of eighty five feet above the stream. Dropping from the cables are the "suspenders," which support a concrete roadway twenty-two feet wide and a footpath seven feet wide.

The supporting cables were built up in place, two strands at a time. Large reels of hard-drawn steel wire, three sixteenths of an inch in diameter, were placed at each corner of the bridge, and the free ends fastened to the anchorage shoes. A revolving wheel, an endless moving cable, shown in one of the illustrations, was then slipped in the bight of these wires and drew them across the bridge gap over the improvised suspension path. On the opposite shore the loop of the wire was attached to the anchorage, and the traveling wheel sent back carrying a bight of wire from the other reels.

This operation was repeated until fourteen ropes, each containing 282 wires, had been built up. More than 9 3 miles of wire was consumed. After the cables were completed, they were lifted into place in their saddles on the tops of the towers, and carefully adjusted until their sag, or vertical sine, was the same as that of a guide wire. At this stage the cables consisted of a loose bundle of parallel wires.

A near view of the pathway, with the wire reels showing at the extreme right

After the engineers had satisfied themselves that the sag was correct, and that the strain on every strand was the same, the cable was compressed in a powerful screw clamp with a circular opening which forced the wires into the form of a round rope. They were then wrapped concentrically with steel wire, as a whipping is put on a fishing rod. An electrical winding machine was used to put on this whipping with the requisite tightness. The last step in the construction was to clamp the suspenders over the finished cables, and erect the steelwork and the roadway in the customary manner.

It would be quicker and easier to form the cables of suspension bridges out of twisted wire ropes, but for an equal weight and diameter a cable of parallel strands is at least 10 per cent stronger. It is also easier to detect and cut out any imperfections in the wire when it is built up strand by strand. In spite of this apparently slow process, the Kingston bridge will be finished in less than a year. The cornerstone was laid in December, 1920, and it is expected that the bridge will be ready for traffic any day.

Plastometer Reads Person's Ability from Contour of Head

THE young woman in the [illegible] with what [illegible] These bumps have long been known to phrenologists, but they have never been able to make readings with [illegible] be a combination sexton [illegible] clamped to her head, is [illegible] of the plastometer measured. A Berlin artist, Dr [illegible] Burger goes further than the manual phrenologist interested in phrenology along with his passion for modeling, invented the "soul and body caliper," which is called a plastometer. It is said to register scientifically the meaning of every cranial depression and protuberance in calibrated degrees of physical and mental weaknesses and powers, and inherent intellectual and manual productivities, with a sureness that would require months of observation by any other method heretofore known.

It is said that the face and head comprise a human dial which the plastometer can interpret with unerring accuracy. One bump tells whether you are musical, another if you are combative, another if you have great by reporting that signals in the surface of the cranium warn of approaching disease and incapacity.

The bumps and hollows of the patient's head are revealed and translated by this strange-looking instrument called the plastometer

NATIVE American weeds might produce three hundred million pounds of rubber a year if it were commercially profitable to exploit them. Dr H M Hall, who has been investigating possible sources of native rubber, believes that the common milkweed and the aster family of plants both produce a rubber sap. The *Chrysothamnus nauseosus*, or rabbit plant, is a promising species that might be used for a source of rubber of excellent quality in case emergencies should close the usual channels of import.

Pumping a Million Tons of Coal from River-Beds

Susquehanna River takes coal rejected from mines and makes it better than colliery's best

THE Susquehanna is the world's champion "coal-bearing" river. It bears this coal not in strata, but in the lumps and dust that are ejected from Pennsylvania's great anthracite mines. This is "reject" coal, and it is estimated that the rejects from the 350 principal collieries in the state amount to nearly 500,000,000 tons a year, much of which is dumped into streams of various sizes that pass the mines.

Now here's where nature jeers at the miner. It accepts all this anthracite waste in its rivers and promptly proceeds to carry it downstream. In the stream-conveyance it bumps this coal about. The operation has come to be technically known as "jigging" or "riffle-washing." When the waste coal has been jiggled for from fifty to a hundred miles, it is found to be a much better fuel than coal fresh from the breaker.

Besides rebuking man for his wasteful methods, nature also transports this enormous lump of millions of tons of coal, free of all cost, to great mill centers, where its easy extraction cheats the collieries out of the sale of their rail-transported product.

The method of mining this dump coal from Pennsylvania river-beds is by the use of ordinary sand-pumps and clamshell dredges. The pumps and dredges discharge on a screen which permits mud and sand and water to filter back into the river, but retains coal.

Thirty-three years ago "river coal" was first extracted by a sand-pump with the idea of its being used. But it was rejected because of its high ash content.

In many intervening years "river coal" was sold by a few sand-pump firms for from fifty to sixty-five cents a ton, sometimes even lower, the buyer doing his own hauling. Then a state geologist became interested in the slowly growing coal-pumping industry and made tests.

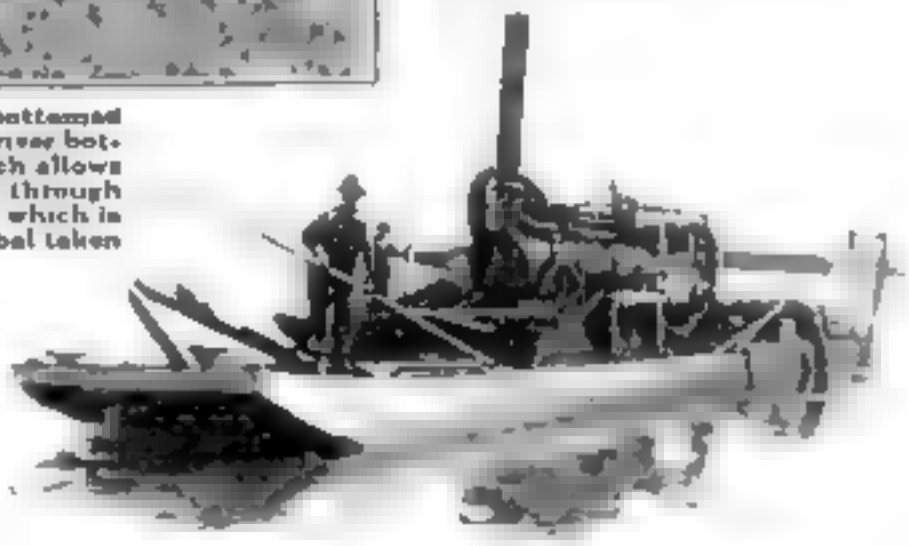
Coal pumped from the Susquehanna at Harrisburg averaged from 15 to 18 per cent in ash content. The same anthracite from the colliery breakers had from 15 to 30 per cent ash content. The dump coal had turned out to be better fuel than the quality grades fresh from the mines! Volume for volume, it was higher in thermal units than accepted coal—just because it had been dumped into a river and allowed to jaz downstream!

An average analysis of river coal showed this splendid composition.

Moisture	3.42	per cent
Volatile matter	3.05	"
Fixed carbon	3.16	"
Ash	13.52	"
British thermal units		11,750

There was a quick right-about, of course, and a big market was at once opened for river coal. During the years of 1919 and 1920, the yield of coal pumped and dredged from Pennsylvania river bottoms was more than two million tons for each year. The Susquehanna and its tributaries had the greatest yield—1,586,000 tons for 1919, and approximately the same amount for 1920. At Harrisburg alone 400,000 tons are being extracted yearly. A little creek called the Shamokin is yielding 750,000 tons a year; 235,000 tons comes from the Schuylkill, 120,000 from the Lehigh.

Huge pumps operated from flat-bottomed scows lift up the wet coal from the river bottom and deposit it on a screen, which allows the mud and sand and water to sift through the mass, leaving only the pure coal, which is much higher in thermal units than coal taken straight from the mines



These coal-pumping dredges are reclaiming millions of tons of low-priced reject coal annually

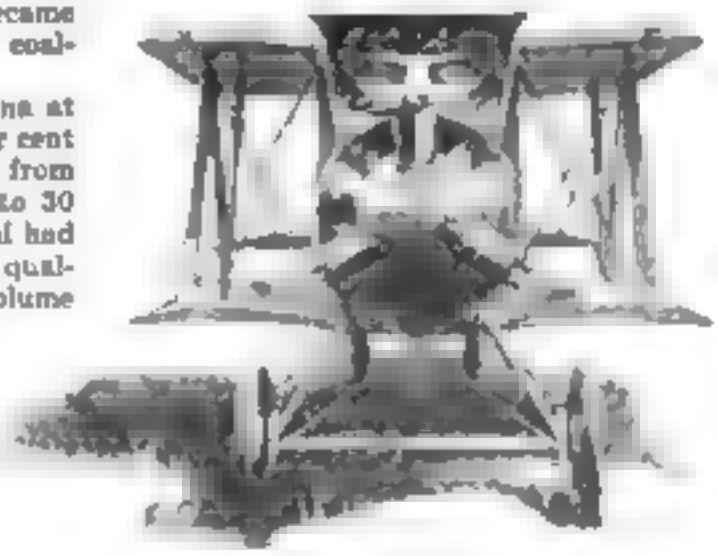
A state geologist poking around in the little Shamokin creek, found one bed of 2,000,000 tons, a thousand feet long and ten feet deep. He mentioned this casually in a recent lecture before Philadelphia coal experts to convince them that the yield of river coal is by no means being exhausted.

Pessimists have said that the supply would last only from four to ten years longer—this term depending on the degree of pessimism. But other experts reply that there are not only twenty-five to thirty million tons still resting in the river-bed, but that the dumping is continuing at the mines.

Before the pumping and dredging of the coal had become a great industry, the waste coal cost the mines a great sum in yearly indemnities to farmers. The river-beds were filling up with coal, and during the rainy seasons overflows were frequent.

However, farming land is no longer spoken of as being ruined by the anthracite sediment. Instead, railway-tracks have been laid out on these flats and the silt is shoveled into coal-cars as soon as a providential flood comes along.

Farmer's Airplane Rises from Barnyard



With wings folded back this five-hundred-pound plane takes up no more room than an automobile

BUILT with wings that fold back against the fuselage so that the plane may be stored in a Ford garage or any barn that will house a two-horse wagon, this new machine, designed by A. K. Longren, of Topeka, Kansas, may prove the Ford of the air. It is one of the smallest practical airplanes ever constructed. The total wing spread is about nineteen feet, and when folded it measures only nine feet wide, seven feet tall, and nineteen feet long.

To prove that the ability to fold the plane was not gained by any sacrifice in strength, on its trial flight the plane was put into two tailspins, nine wave loops, and a barrel roll, which shows that its wings are as strong as those rigidly connected to the fuselage. Although the plane weighs only five hundred pounds, it will carry a useful load of the same amount and is equipped with a sixty-horsepower motor.

Its outstanding feature is its ability to take off and land in confined spaces. It will leave the ground after a run of 125 feet and land in seventy-five feet, so that it may be brought down on a field of ordinary size and is independent of elaborate landing-fields and hangars. This makes it an ideal machine for farmers and professional men who are awake to the advantages of the airplane for inspection trips, patrolling forests against fire, and for long flights to examine property far from ordinary lines of communication.

Basset Process Makes Steel Direct from Ore

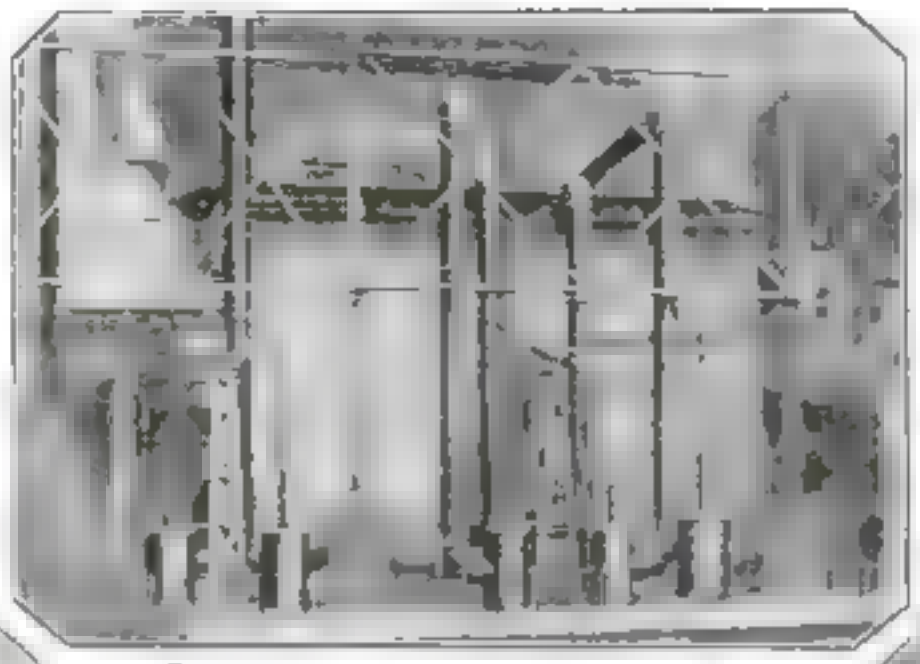
PRODUCTION of steel direct from the ore in five hours is the revolutionary accomplishment of the French scientist, M. Basset, whose process is now said to be developed on a commercial scale.

For years metallurgists have dreamed of a direct steel process, eliminating the spectacular Bessemer converter. Numerous methods have actually been tried out, but the Basset process is the first one for which really sweeping claims of success are made.

In the most efficient blast-furnaces far more coke is supplied to the charge than is theoretically needed to reduce the iron ore. The result is that the molten iron, which dissolves carbon almost as water will dissolve sugar, takes up an excessive amount of this element which must be burned out of the pig iron by the open hearth or Bessemer process before steel can be made. In other words, the iron is first carefully supplied with too much carbon, and then the excess of carbon is laboriously burned out. This takes time and fuel, of course.

Basset has apparently solved the problem by mixing the iron ore with limestone in a rotary furnace. There is no coke in this charge, as is the case in the usual blast furnace. Instead, the carbon is supplied as finely pulverized coal, which is carried into the furnace by a blast of air heated to 1800° F. The quantities of air and coal blown through the ore are carefully regulated, so that the combustion in the furnace is incomplete. Even after all the oxygen is taken from the ore, the coal is only half burned. The gases given off from the ordinary blast furnace are largely carbon dioxide, CO_2. The Basset furnace produces only carbon monoxide, CO, which will not re-oxidize the metallic iron.

The high temperature of the Basset blast is obtained by passing the air through brick retorts that are heated by the gases given off by the furnace itself, which proves that the combustion is only half completed in the presence of the iron. Nevertheless, the heat produced in the furnace is amply sufficient to melt the iron, which is poured into molds in the usual way. When a pound of carbon is burned, about a thousand heat units are emitted in forming carbon monoxide, and nearly two thousand more when the monoxide burns to form the dioxide. By making these two steps take place in different furnaces, M. Basset reduces and melts the ore without danger of re-oxidizing it, and still gets enough heat energy from the pulverized coal to heat his air blast.



Brick retorts for superheating the air blast to 1800 degrees. They are fired by the carbon monoxide given off by the ore furnace

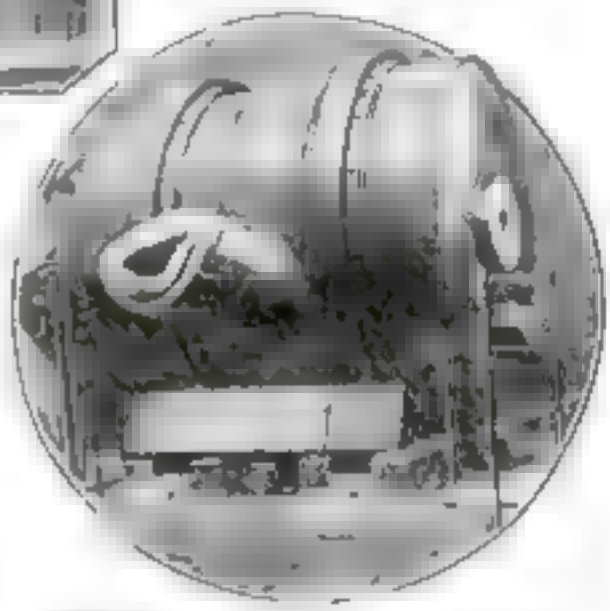
The hot blast is charged with a measured quantity of powdered coal dropped through the small pipe

The new process will produce steel from ore in five hours. With the blast furnace it takes thirty hours.

Reports from Paris assert that in addition to the saving in time effected, iron can be produced 70 per cent cheaper than in a blast furnace, and 80 per cent is saved in the cost of installing the plant. The cost of subsequent operations in the manufacture of steel is also reduced, as the exact control of the amount of carbon supplied to the metal and the heat of the blast allow steel to be withdrawn directly from the furnace.

There are still many skeptics among metallurgists as to the commercial possibilities of the process, but M. Basset expects from it far-reaching benefits in France, since a poorer and cheaper grade of coal can be employed in smelting, and France will be enabled to make steel with the coal found within her borders, instead of importing coking coal from Germany and England.

Here in the United States, we have an abundance of good coking coal, and the steel operators are naturally loath to abandon their expensive blast furnaces until it becomes necessary or profitable for them to do so. In the West, however, where good coking coal is scarce, a successful process of this kind might help to build up a locally profitable steel industry.



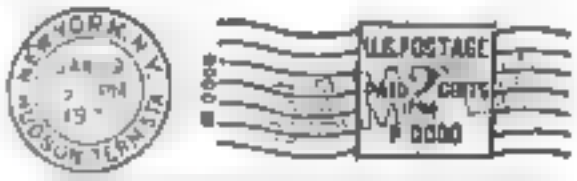
Lined with refractory clay, the reduction furnace tilts to pour off the molten iron and slag

Printing Our Own Postage Stamps

HAVE you received a piece of "metered mail" yet? You are certain to before long. For the newly invented postage meter is being adopted by [illegible] to speed up their outgoing mail. It will mark, stamp, seal, count, and stack mail at one operation, and at the rate of forty pieces a second.

The desk model postage printer takes up but little space and is hand-operated

Instead of using postage stamps, the machine prints the date, the time, and "Postage Paid" on the envelope, using ink of the color of the stamp—green for one cent, red for two cent, and so on. Yes, but how is the Government sure it is being paid if no stamps are used on letters and parcels?



This is the style of postmark printed by the postage meters

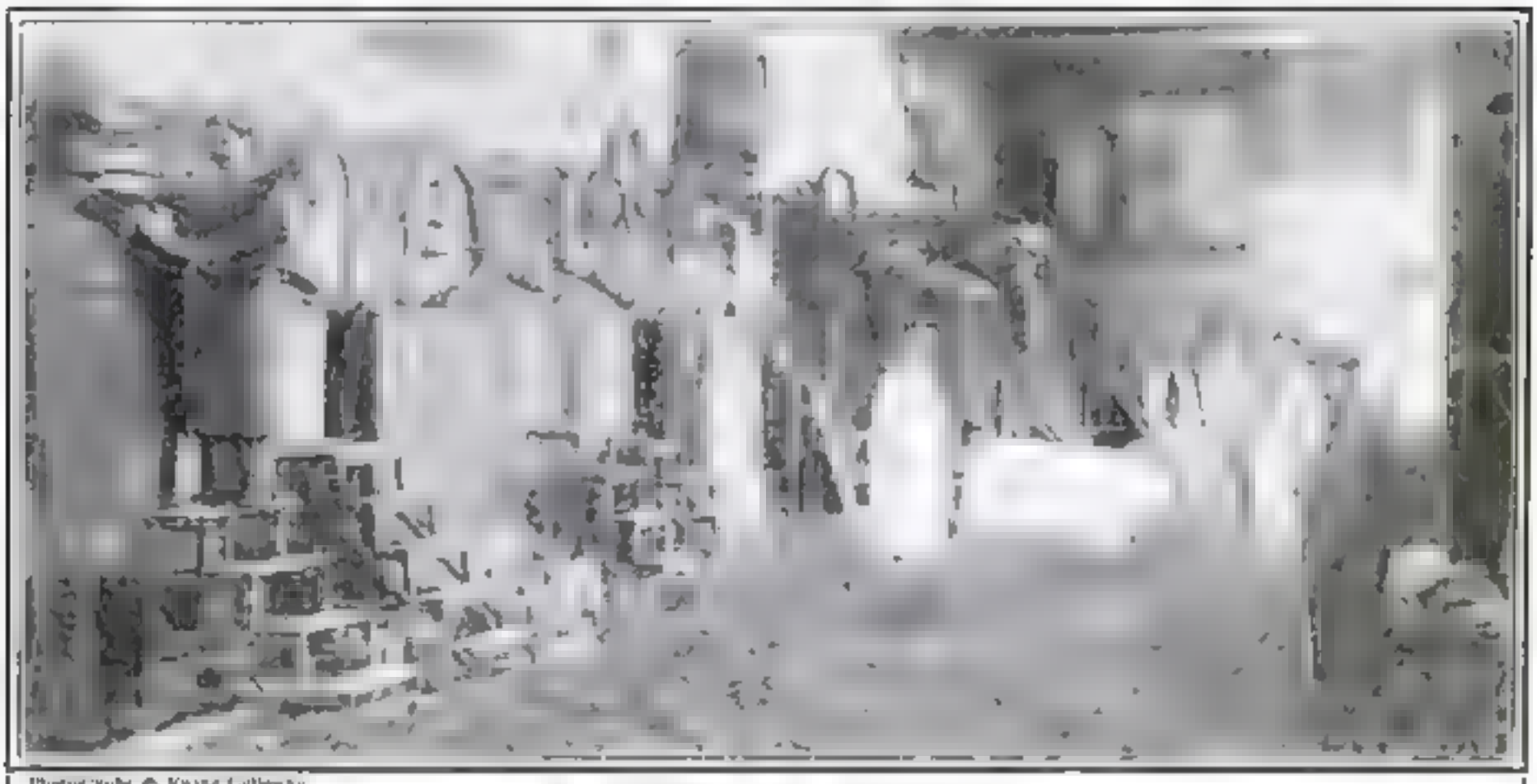
The meter attached to the machine is taken to the post-office, a payment is made, and the clerk unlocks the meter with a key in his possession. He sets it to print as many "Postage Paid" lines as you have purchased stamps and no more. After the last impression, the meter locks and must be taken to the post-office again.

For large business houses the motor-driven machine will postmark 250 letters a minute

1929

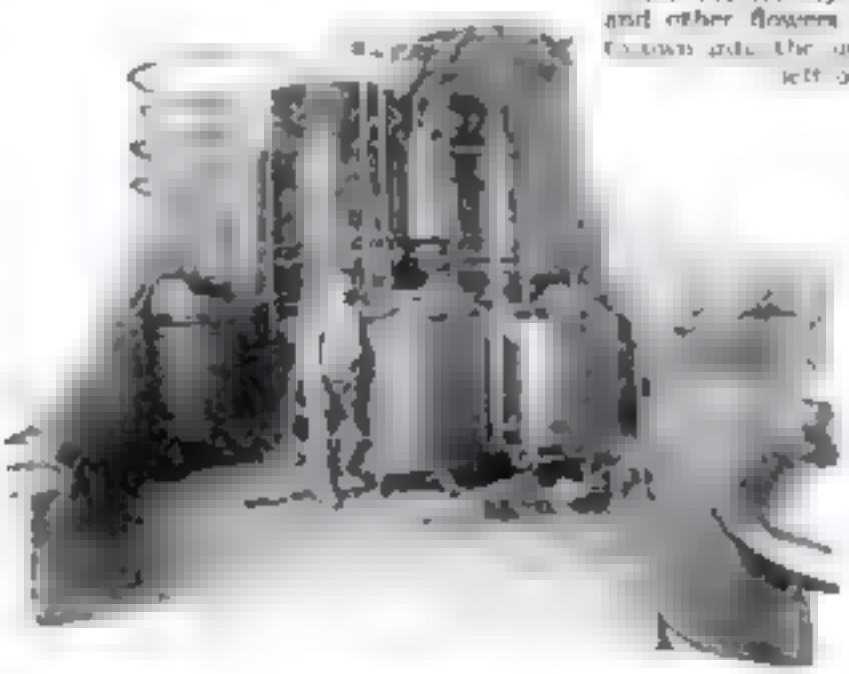
The Perfume Industry of France

Where the rose, jasmine and cassia are robbed of their odors



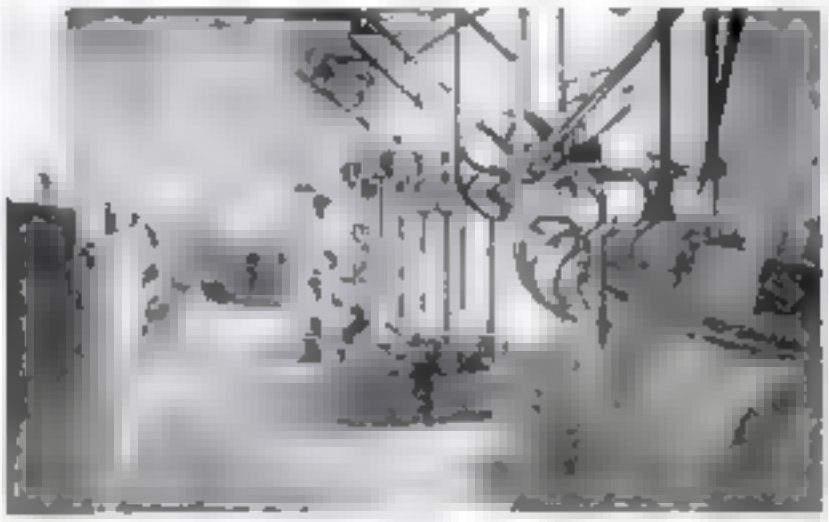
Photographs © Keystone Collection

The receiving-room of a perfume factory, where the freshly picked leaves of the rose and other flowers are dumped before being [illegible] and the huge co[illegible] shown at the left of the picture



A corner of the distillation room, where the flowers are distilled with water or superheated steam. The method of treatment varies with each flower or herb that is used

The mixing-room, where the attars are mixed in the proper proportion to obtain the exact scent. Most of the natural perfumes are mixed in solution with alcohol



Some perfumes cannot be obtained by distillation, but are gained by maceration or inflowering both processes requiring a mixture with fat, and the perfume is then squeezed from the flower or fruit by these hydraulic presses

The essence secured from the flowers must be tested constantly in the laboratory to be certain that the final perfume does not vary the most careful measuring of ingredients never producing the same strength twice

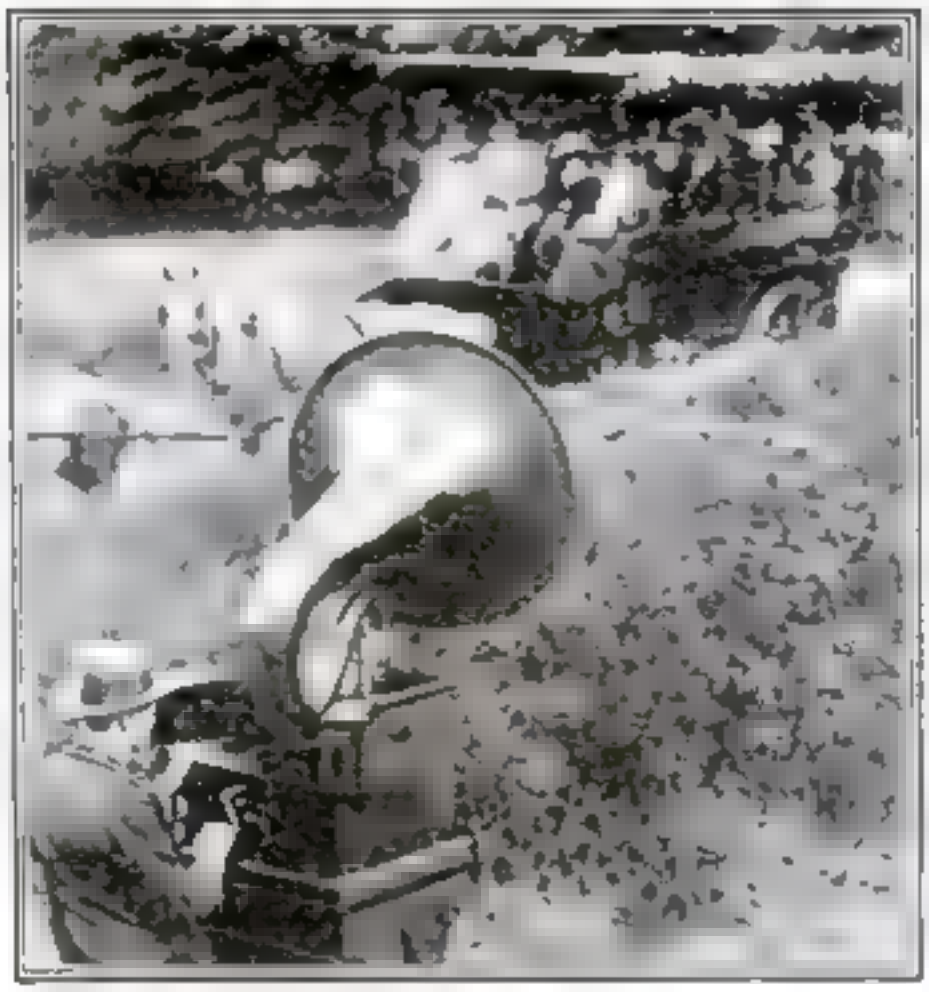
Music Now Comes on the Movie Film

MUSIC is always served with moving-pictures, but if it isn't appropriate, it may easily spoil the effect of a picture.

We can now have music and pictures combined on a film in the manner shown here.

As the film is made up, music is selected and is reproduced along the lower edge of each section of film. Then, when the pictures are projected on the screen, the music will appear at the bottom where it is in full view of the man at the piano.

Suitable music for each picture is printed on the film



Enlarged Phonograph as a Vocal Sign-Post

IT is the custom in England to drive out to the Derby to see the races, and in the past, parties sometimes lost their way over unfamiliar roads. An English newspaper decided that the ordinary guide-posts were not enough, and installed a loud-speaking phonograph at every important corner.

The machine depicted shouted "To the Left! To the Left!" all day long. The loud-speaking attachment on the phonograph made it sound as loud as a man can shout.

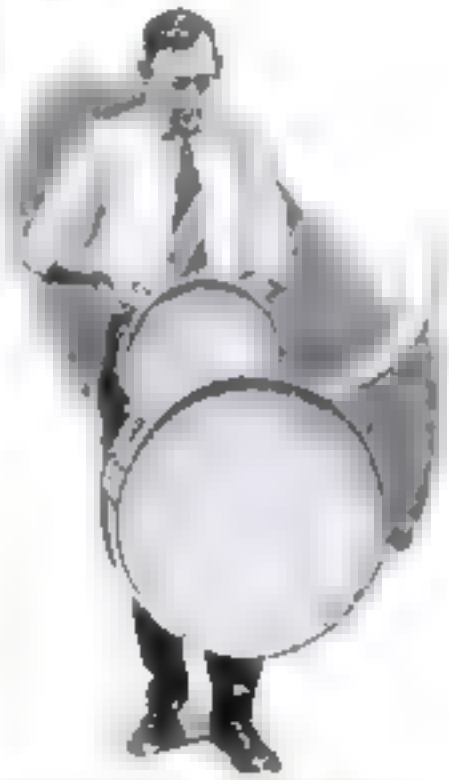
The invention was developed during the war to permit aviators to shout instructions to troops, even when flying a thousand feet above the earth. In the September issue, Popular Science Monthly printed an article on the invention of this amplifier.

Here Are Two Drums in One

FOR orchestra and band members this two-in-one drum will be found convenient. Not only may a smaller drum be placed into the larger one, but parts making up the drummer's trap supplies may also be placed inside.

The accompanying illustration depicts this novel instrument and the manner in which the small drum is inserted.

All that is necessary is to place the smaller drum and adjust the pedal to the larger, is to attach a hidden device that is built in the shell of the drum.



Showing how the small drum is placed inside the large one

Grandstand from Ammunition Boxes

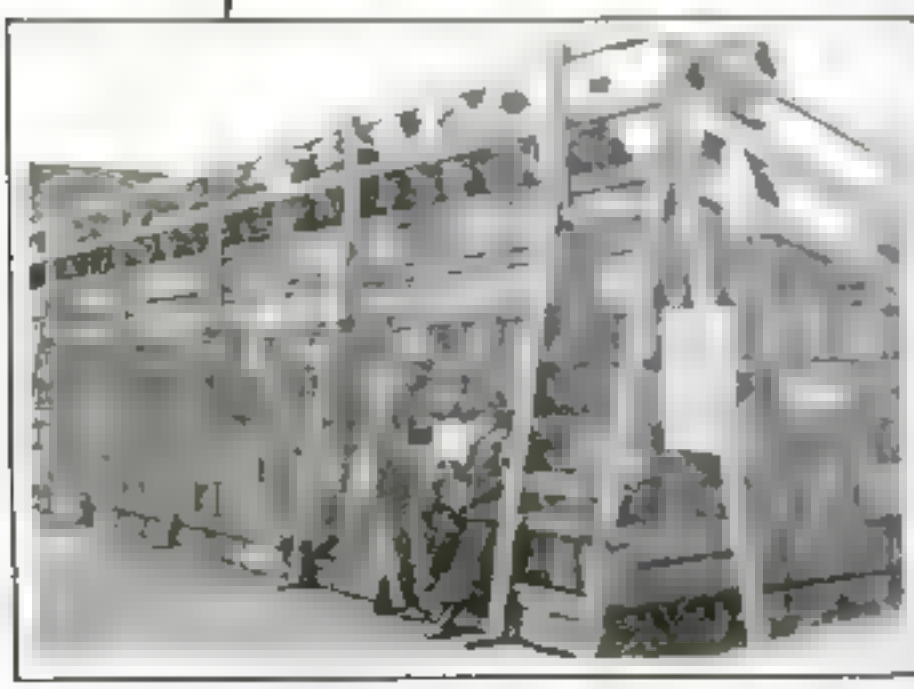
SALVAGE of the war is now improving the standards of sport in England. This grandstand for the tennis matches at Wimbledon is constructed of ammunition boxes.

Unlimited amounts of these boxes can be had almost for the asking, and since they are about ten inches square and are exactly the right height for seats, no additional lumber is needed to make the stand. Virtually no carpenter work was needed for this job, as the boxes could be put by common labor. They were received from the army with the corners already screwed on. As they were made of smooth [illegible] they were already painted. The stands were quite [illegible] and gave perfect satisfaction.

A Homemade Silencer for the Motorcycle

THE innocent little section of stovepipe that this man has attached to the muffler of his motorcycle is the terror of every dog in the surrounding countryside.

People complained that this man's motorcycle made too much noise. He is an enthusiast, and they declared he rode about so much they were unable to sleep. They became so bitter about the matter that he put on the pipe which performs perfectly as a muffler. His machine is now almost noiseless. He travels down the road [illegible] except for the sound of the tires on the road and the clicking of the engine-valves, there is nothing to cause annoyance.



Ammunition boxes brought back from France to England were used to build this grand stand

The piece of stovepipe on the motorcycle is a muffler and not a patent traveling stove

Scissors Create Scenery for Silhouette Movies

NOTHING less expensive for motion-picture production will be discovered than the new German silhouette film dramas. Double-exposure of the negative and the slipping out of small scenic frames of black cardboard [illegible] produces the settings.

First, the negative is exposed to the motion of the silhouetted human figures, light being thrown on them through a screen, their camera side being wholly dark. The number of feet of each "shot" is carefully booked, and the negative next run through for a second exposure to take the setting, which need be no larger than a few inches.

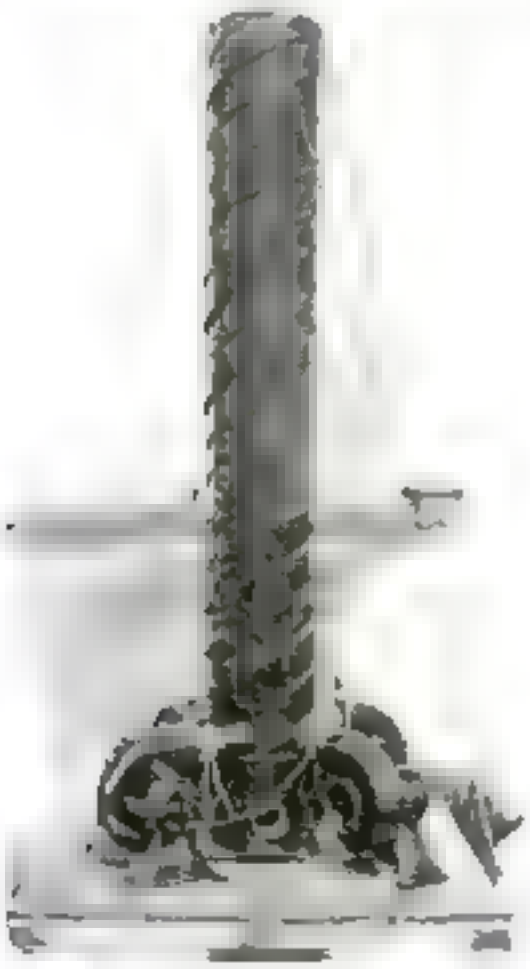
Earth-Borer Plants Dynamite

IT is tedious work to bore holes in hard soil by hand, yet this must be done before dynamite can be used to shatter hard soils and form holes in which to plant trees and set poles.

A portable earth-boring machine, invented by an Illinois man, greatly simplifies the work. The device consists of a set of light tubular hinged frames, the ends of which are fitted with gear-driven boring-gears to operate the augers. The machine will drive four drills more quickly than one drill can be operated by hand. Since the holes are spared fifteen feet apart in the form of a square, hard-pan can be drilled rapidly for subsoil blasting.

The framework is designed to fold up and can be carried on the chassis of the automobile, the engine of which furnishes the power for the drilling.

Rain-Making Machine to Produce Natural Storm



The miniature tornado produced by these high-speed blowers is guaranteed to bring rain

FOUR blowers of one twentieth horse-power each, which force air through a spiral pipe at 1100 cubic feet a minute with a velocity of sixty miles an hour are the features of a rain-making machine with which it is proposed to produce natural storms by artificial means.

After considerable research it is the inventor's belief that by forcing warm air from the earth's surface up into high altitudes, an ascending chimney, or miniature tornado center will be created which will eventually produce an area of low barometric pressure with its accompanying fall of rain. By changing the position of air gates in the base of the machine it is expected that a high-barometric storm may be produced whenever desired.

The illustration is a model. The full-sized machine will consist of high towers and motors of five hundred horse-power. While it is probable that the area of high or low pressure could be [illegible] artificially [illegible] doubtful if any human machine could [illegible] the hundreds of millions of tons of air involved in a space of time sufficiently short.

Portable Typewriter for the Blind

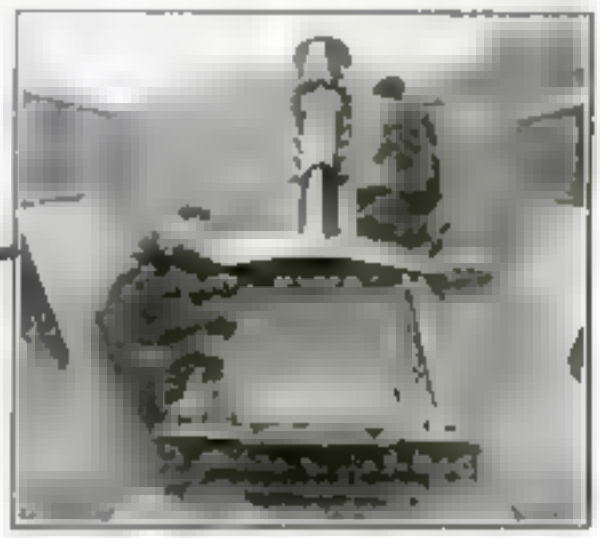
THE German government is marching abreast of the Allied governments, in teaching many of the men blinded in the war to earn their living as typists.

The illustration shows a special machine invented for use by the blind. The letters on the [illegible] are inverted so that the machine may be operated by feeling with the finger-tips.

No typewriter ribbon is used. A thin printing ink from a reservoir on the right is distributed over the type by a roller.

Raised letters on keyboard allow the blind to operate this portable typewriter

Is your mind as keen as you think it is? Test it with the Sam Loyd Prize Brain-Twisters on page 74



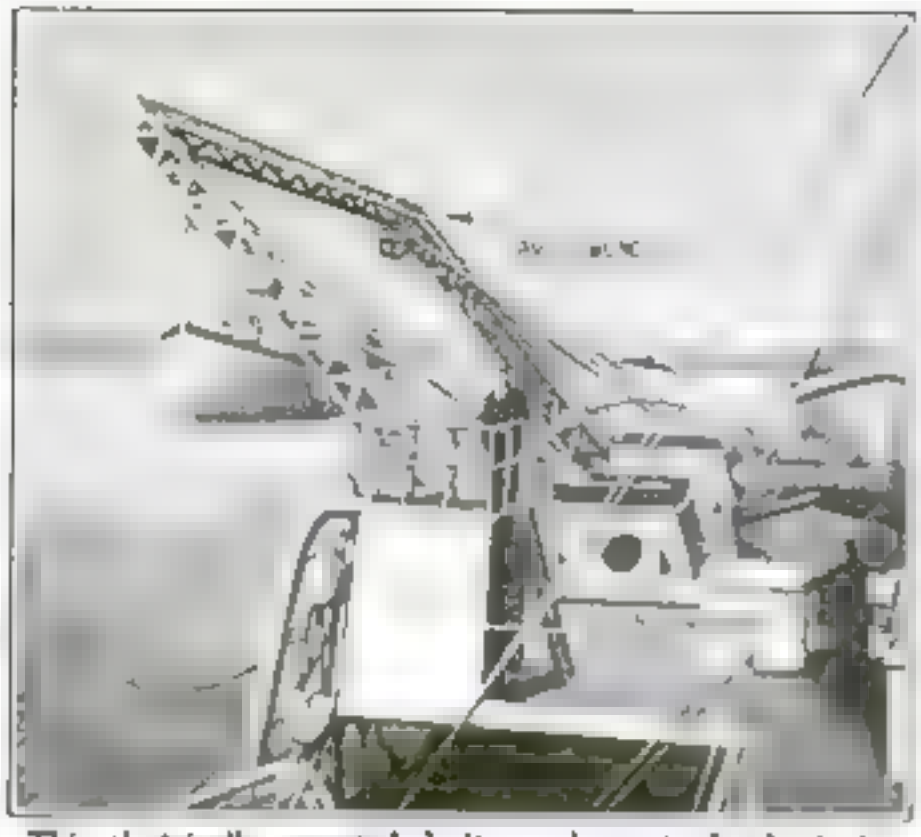
Coal-Pusher Saves Labor of Locomotive Firemen

FEW athletes have been known to train by taking a job as a fireman on a locomotive. Even if union rules did not forbid, they would probably find the work too hard and prefer some comparatively lighter toil like blacksmithing or lumbering. Indeed, the task of firing a modern freight locomotive is so arduous that the last "knights of the shovel" are being overworked, and the gigantic shovel shown in the sketch is being installed to lighten their labors. It is operated by compressed air, and pushes forward the coal in the locomotive tender on to the firing deck as it is needed.

New Process Extracts Oil from Apricot Kernels

APRICOT kernels, formerly considered as waste, are now being pressed to remove the oil, which has been found useful in making salad-dressing and for frying.

Hydraulic presses with a pressure of five tons to the square inch extract the oil without the use of heat. Futhermore, it is not necessary to refine the oil before it reaches the customer. About twenty-five thousand kernels are needed to make one gallon of oil.



This electrically operated davit can lower twelve boats in nineteen minutes, and is not made inoperative by the listing of the ship

Davit Lowers Lifeboats Quickly

IN order to save the minutes which are so precious in time of disaster, lifeboat davits of a new type have been installed on the SS *Arundel Castle*.

Davits have always had a bad habit of jamming or of lowering the lifeboat unevenly in an emergency. Another fault has been their inability to do the work when the roll of the ship was too great or the list too heavy. This new davit is said to overcome both of these handicaps.

As the illustration shows, it consists of two counterbalanced davit arms connected by a rigid framework. When standing inactive, the davit is swung inboard out of the way but when the electric motor is started the davit swings out and so lifts the boat just enough to clear the ship's railing before it is finally lowered away.

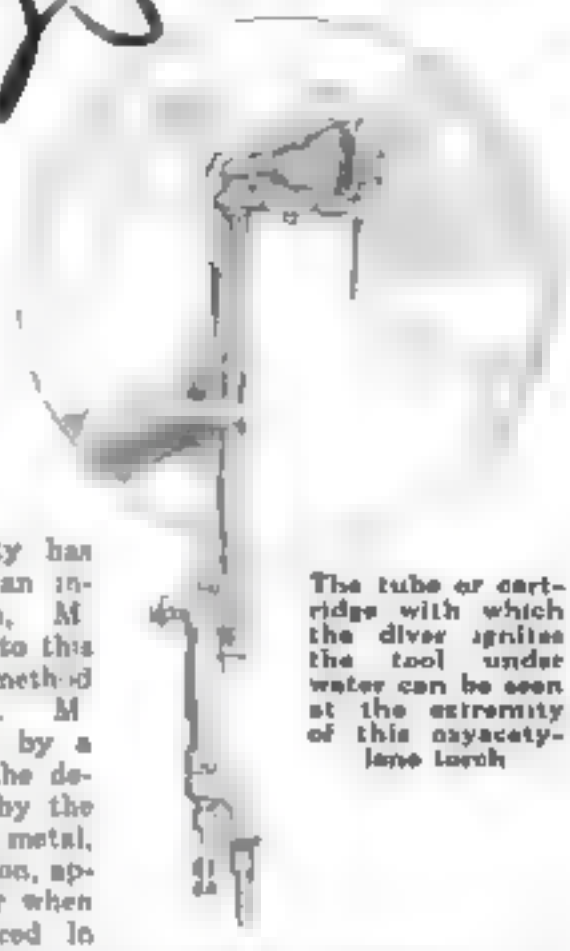
As each of the lifeboats holds sixty persons and twelve boats can be lowered from each davit in nineteen minutes, it is easy to figure how quickly the passengers of the large ocean liner could be handled

The Diver Can Now Light His Gas Torch under Water

THE method whereby an oxyacetylene cutting flame is made to burn under water is simple. The tip of the torch is covered with a bell, to which compressed air is admitted at a pressure sufficient to keep out the water, this pressure being regulated according to the depth at which the work is being done.

The difficulty with this process is that the diver is forced to light the torch at the surface, and descend with it burning. If the flame is accidentally extinguished, which happens often, the diver is forced to the surface again to rekindle it. This entails a great waste of time and effort.

However, the difficulty has now been obviated by an invention of a Frenchman, M. Corne, who has applied to this peacetime problem a method developed for war use. M. Corne starts the torch by a flame generated from the decomposing water itself by the use of a secret alkaline metal, which, from the description, appears to be sodium, for when metallic sodium is placed in water, hydrogen is liberated and much heat produced, in fact, the reaction is so rapid that an explosion sometimes occurs. But as no free oxygen is produced, M. Corne, to get his reaction, adds an oxidizing compound. With the alkaline metal this oxidizing agent is enclosed in a brass tube pierced with vent-holes and provided with a hinged core to prevent accidental ignition of the materials.



The tube or cartridge with which the diver ignites the tool under water can be seen at the extremity of this oxyacetylene torch

The lighting device is placed near the tip of the torch on a jointed rod. When the diver has been lowered to the ship's side, to the lighter, he turns on the compressed air in the torch, admits the water, and in a second the oxyacetylene torch is lighted and he can begin to cut the steel plates.

Odd Trolley-Car to Give Local Service from Express Trains

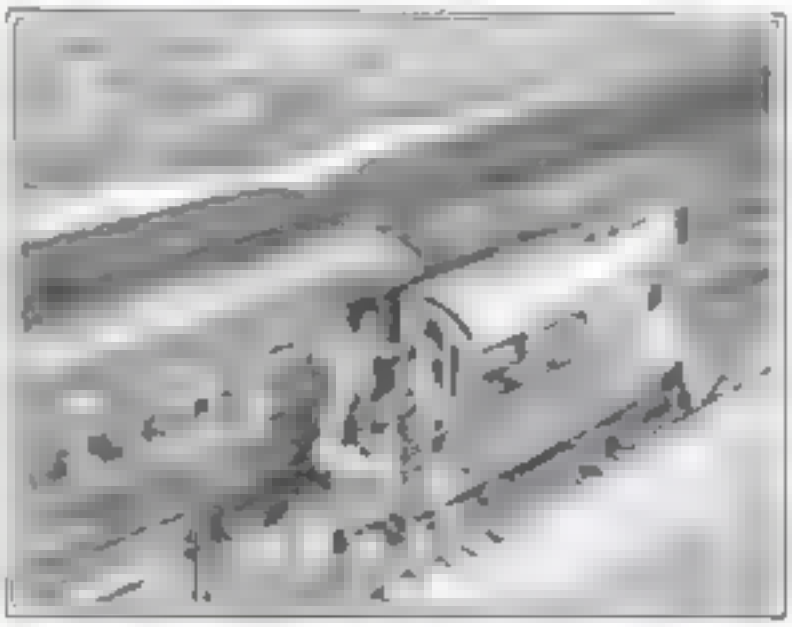
STEPPING off an express train going at sixty miles an hour sounds more like suicide than practical railroading, yet this apparently wild scheme has been proposed in order to shorten the time spent by the commuter in traveling between his office and home.

When the commuter steps off the train, he steps on to the platform of a trolley running on tracks parallel to those of the railroad at the same speed as the train. As soon as all the passengers are aboard, the trolley puts on the brakes and draws up at the local station, while the express train goes on without slackening speed.

The passengers would have to be standing in the aisles waiting for the trolley to pull up alongside, for a few moments lost in disembarking would require too long a stretch of trolley track. Even under the most favorable conditions, this track would have to be nearly three miles long – about a mile to get up speed, a mile and a half, or ninety seconds, to take passengers, and a half mile to slow down.

Accelerating electric motors make the trolley able to get up headway sufficient to keep even with the train in a very few seconds. Although the train might be going a mile a minute, it would be no more difficult or dangerous to step on to the platform of the trolley than it is to walk from one car of a train to another, since neither platform would have any motion relative to the passenger.

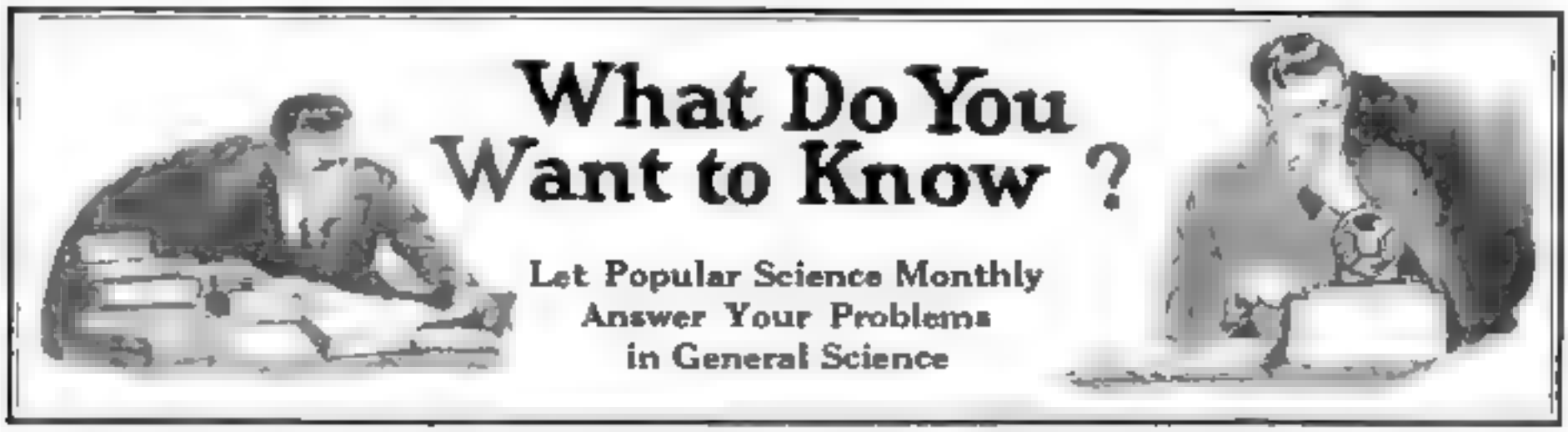
Not only would a scheme of this nature provide better service for the commuter, but because the stops made by the express would be reduced, the cost of operation would be lowered.



These illustrations show how the transfer between express trains and local stations would be effected

Good Lumber Cut from Dead Trees

WHEN sound dead trees are sawn into lumber, there is no method known to the United States Forest Products Laboratory by which the wood can be distinguished from that obtained from live trees. If the tree stands on the stump too long after it is killed, the sapwood is liable to become badly damaged by wood-boring insects, and in time the heartwood will be similarly affected. The heartwood of all trees is entirely dead, and only a thin layer of cells just under the bark is actually living, so most of the lumber cut is sawn from dead wood, whether the tree itself is dead or not.



Other Readers' Questions that Will Interest *You* Too

Is pure radium really used in making the luminous figures on watch-faces? If so, how is it that they can be sold so cheaply? E. H.

No, the material on luminous dials consists of a minute quantity of a radium salt mixed with some phosphorescent substance as sulphide of zinc or barium. Such a combination will glow more in the dark than would radium, which, in its pure state, is not luminous. The reason that watches with luminous figures can still be sold cheaply is due to the fact that only an infinitesimal quantity of radium salts is needed to impart unusual luminosity to the inert salts of barium and zinc.

??????????

What is pongee? Does it come in any other color than tan?—J. K.

Pongee is a soft, unbleached, washable silk, made in China from the cocoons of wild silkworms. In its natural state pongee ranges from light pearl to tan in color, depending on the foods eaten by the worms, but it is frequently dyed for commercial purposes.

??????????

At what altitude would a human being die for want of oxygen?—A. L. O.

This depends on the individual. Some persons would faint at eighteen thousand feet, while others could achieve twenty-five thousand feet before feeling any ill effects. At something over twenty-five thousand feet, however, the average person would die for want of oxygen.

??????????

Can you tell me the area of the Pacific Ocean?—M. C. G.

It is impossible to define exactly the limits of the Pacific, but if all the seas bordering on it are included in the computations, the area would be approximately fifty-five million square miles.

??????????

What is ordinary gelatine made of? Where is it obtained?—F. K. I.

Gelatine is a substance made by dissolving in hot water certain parts of the bones and tissues of animals. Its exact chemical make-up is unknown.

??????????

Is there any difference between a hydroplane and a hydro-airplane?—S. A. M.

The term "hydroplane" is usually applied to motor-boats having the flat or V hull or a modification of either. A hydro-airplane is an airplane with a body that allows it to rise from and alight on the water.

??????????

What are the advantages to a ship of having a gyroscopic compass? P. S.

Once set to point north and south, the needle of a gyro-compass is not affected in any way by the motion of the boat nor by the near-by presence of metallic bodies.

??????????

What is the composition of brass; of bronze?—J. G.

Brass consists of about 30 per cent of zinc and the remainder of copper. Bronze consists of copper and tin in various proportions, according to the use to be made of it. For coins or tokens the proportions are 95 per cent copper and 5 per cent tin. A slight addition of other substances, such as phosphorus, zinc, or aluminum, produces other alloys known as phosphor-bronze, bearing metal and aluminum bronze.

??????????

In dyeing cloth at home it is necessary to buy and use one kind of dye for woolens and silks and another for cottons. Why cannot the same dye be used for both fabrics?—I. S. E.

Wool and silk are of animal origin. Cotton is from a plant and consists principally of cellulose. Being of animal origin, woolens and silk are more active chemically than cellulose products, and will combine directly with many dyes. But cotton cloth demands a substance known as a mordant before dyes will affect it. Aluminum hydroxide is one of the mordants that make possible cotton dyeing with special basic dyestuffs.

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What is the average velocity of a "shooting star?"—W. A. B.

Shooting stars have a speed estimated to vary from twenty to forty miles a second.

??????????

Some time ago I read of an Eastern professor who was making plans to send a rocket to Mars. What has become of the project? C. I. P.

The moon, not Mars, was to be the rocket's objective. Professor Goddard, of Clark University, who was responsible for the original idea, is still carrying out preliminary experiments on smaller rockets. As soon as the most efficient type has been devised and tested, it is expected that a large rocket will be sent off on its long journey of 200 000 miles to the moon.

??????????

What is the commercial cost of liquid air? For what purpose is it mostly utilized?—E. S.

Liquid air costs about two dollars a gallon. It is used in the manufacture of nitrogenous fertilizer in experiments with low temperatures and in the separation of gases.

??????????

If a man held a light and a heavy article and let them fall from the same height at the same instant, would not the heavier article reach the floor first?—O. M. S.

Yes, unless the experiment were conducted in a vacuum, in which case they would reach the floor simultaneously. "The speed of a falling body is not inversely proportional to its mass" is a fact that was discovered by Galileo in 1590.

??????????

What voltage would be needed to run a 20 or 25 horsepower motor?—J. E. H.

The voltage required would depend upon the motor; it might be designed to run on 220, 550, 1200, or even higher voltages. The most desirable voltage would depend on the use to which the motor will be placed. Your question is vague.

Learn here the answers to many interesting questions asked by readers of Popular Science Monthly.

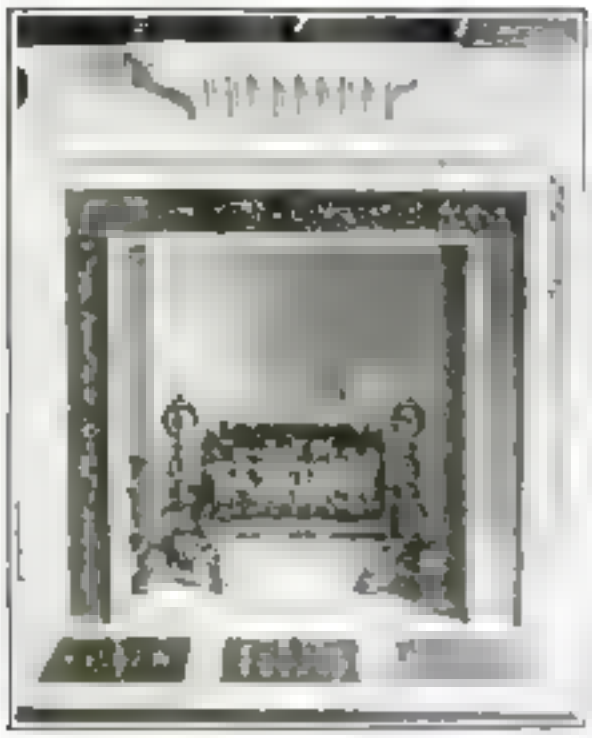
And ask questions of your own.

Every reasonable specific query in the field of general science addressed to this department will receive a prompt reply.

Readers who understand this service will appreciate, of course, that we cannot accept questions involving extensive research, answers too lengthy for the space of a letter, and sets of questions that can best be handled by individual study of available reference books. Legal and medical queries cannot be answered.

A stamped self-addressed envelope must accompany each question.

Address the Editor, Popular Science Monthly, 225 West 39th Street, New York.



An Open Fire without Smoke and Dirt

THIS looks like a coal-fire. The heat is the same, the same flickering light plays on the hearth and dances from the polished andirons—but there is no smoke and no dirt. A grate filled with colored chunks of Belgian glass, two electric lights, a pair of fans with aluminum blades, a switch, and an electric heater have solved the problem of how to combine the convenience and cleanliness of electric heat with the romance and beauty of the open hearth fire.

The lamps shining through the lumps of glass give them the appearance of blazing coals, and the heat arising from the electric heaters makes the two aluminum fans revolve just fast enough to cast the flickering light characteristic of the open fire over the room.

Wooden Tone-Arm for Use on Phonographs

RADICAL changes in design mark the wooden tone-arm for phonographs that has been invented by B. C. Rapp, of Plainfield, New Jersey. The arm is made of solid wood and is attached by a linen thread to a sounding-box fixed immovably in the center of the instrument.

The ordinary metal needle is used, but the inventor claims the position of the tone-arm permits the sound-box to rest on the record at an unusually small angle. As a result the needle slides more easily over the surface of the record, and scratching and harsh, metallic sounds in repoduction are reduced to a minimum.

The tone arm is built of wood similar to that used in the construction of violins, and the complete device is said to add to the beauty of tone of the music, and to prolong the life of the records considerably.

TRACING migratory birds by attaching metal bands to their legs has been practised since 1710. Hunters finding such birds should communicate with the Bureau of Biological Survey, Department of Agriculture, Washington, D. C.

Rapid Interest Indicator for Savings-Banks

A NEW system and device for quickly finding, displaying, and indicating interest on savings accounts of various amounts at various rates of interest, has been invented by Harry S. Moir.

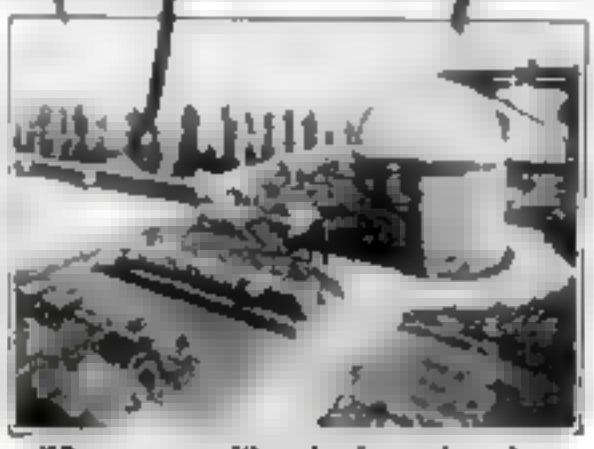
The function of the invention is to locate quickly the amount of interest on an even sum of money for an even period of time without calculation or eye strain. This makes it possible to find the correct interest expeditiously, notwithstanding items of deposit and withdrawal. For example, if a savings account at the beginning of a year is $10,000, the correct interest in anticipation of said amount being left in the bank at 4 per cent amounts to $400. Suppose the next deposit is $2[illegible]. The interest is found by moving the gate-holder [illegible] the pointer [illegible] to 2[illegible], thus [illegible] the gate so as to open the [illegible] slot on the January column, which shows the interest on this deposit to be $4.90. Thus, in posting, it is necessary only to slide the gates from one of the columns to another, according to the date of deposits, and adjust the indicator according to the amount.

The complicated interest computations of banker and broker are handled easily by this attachment

The interest items are totaled on an adding-machine and the interest on withdrawals subtracted, giving the balance to be credited the depositor.

A Country Estate Built on a Factory Roof

IN Cleveland, the manager of a manufacturing concern [illegible] factory [illegible] which [illegible] in [illegible] stores



What appears like a back-yard garden is in reality a miniature estate on a factory roof

atory with a powerful telescope, and an extensive greenhouse used in raising vegetables for the firm's cafeteria and cut flowers for the offices and clubrooms.

Cypress and fir-trees planted on the roof give it the air of a genuine garden. All employees of the firm have free access to the garden. The beauty of the spot, with the view over Lake Erie, less than two hundred feet away, makes it a favorite gathering-place the year round. The garden has been laid out after a plan inspired by examples of the Spanish Renaissance.

Rotary Photo-Print Trimmer

WET or dry photographic prints may be trimmed with this rotary cutter, which cuts more cleanly than the guillotine type, and which will handle a dozen prints at once. The tracks rods support a cutting disk mounted on a wooden drum. The disk is rotated by a rawhide belt as the handle is pushed back and forth, and automatically sharpens itself by contact with the steel bed plate.

Contractor's Truck Carries Double Hoppers

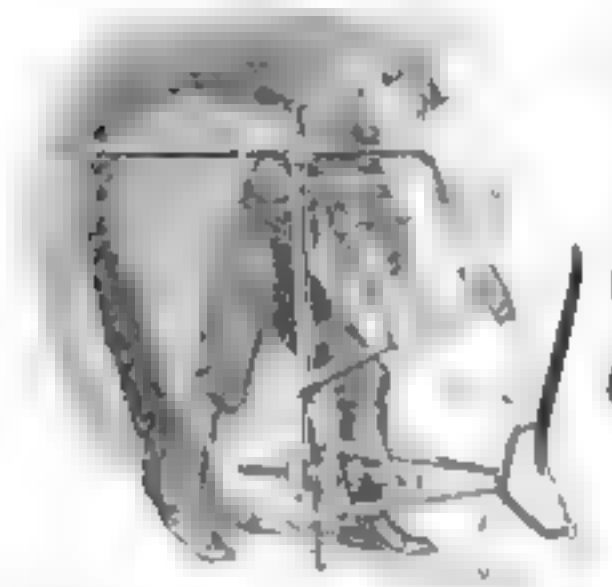
SO as to meet the demand for a truck that will handle building material expeditiously, and at the same time work in confined spaces and on soft ground, this new vehicle has been designed embodying the features that the experience of the building contractor has shown to be necessary.

The short wheelbase makes it easy to turn on an eighteen-foot subgrade. Pneumatic tires permit operation on soft ground and prevent the subgrades from being broken down. Smaller wheels on the front reduce the turning radius, and as all the load is carried on the rear wheels, the truck is just as safe as if larger and more expensive tires were used on all four wheels.

A divided truck body helps the contractor who handles several kinds of material

To unload, the driver raises a safety catch with a trip-bar and gravity does the rest. The shock is absorbed by the coil-springs in front of the hopper, and the tilt is controlled by a chain. These features allow merely a part of the load to be dumped. All working parts are protected from dirt. A three-point suspension motor prevents the transmission from being injured by road distortion.

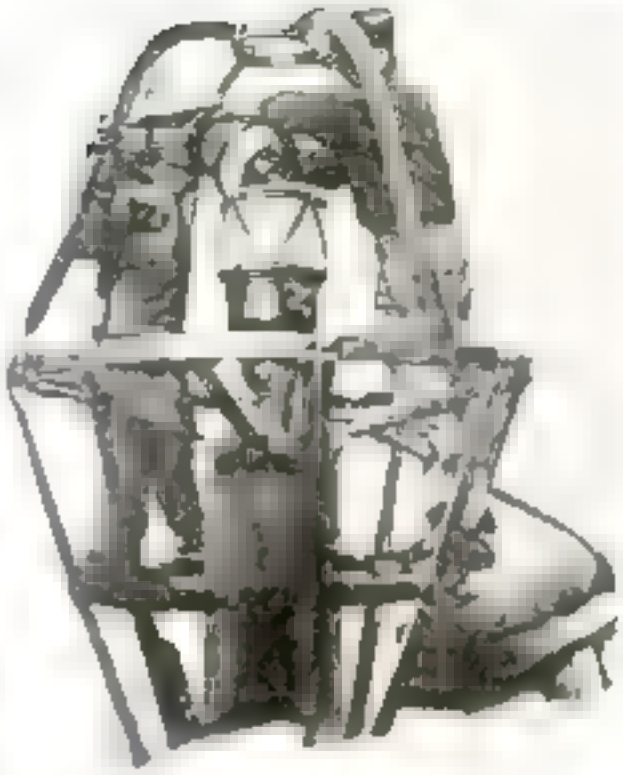
A Hand-Power Drill for Prospectors



FOR over eight years John M. Calderwood sought to invent a mining-drill that would give the prospectors of the West the benefits of power drilling by a machine light enough to carry over desert country on the back of a burro and easier and more efficient in operation than the laborious hand-drilling incident to the use of single and double jack-hammers.

The illustration shows the successful outcome of his experiments. The Calderwood drill consists of an upright column with a standard screw-jack on the top and bottom for putting the machine in position in rather narrow shafts. Sliding on the column is a collar holding a carrier mounted on a trunning segment, which can be fastened [illegible] by set screws. It will be seen that this construction permits two complete circular movements of the drilling-tool, one vertically and one horizontally; adjustments can be made to the fraction of an inch in from one to three minutes.

A hole can be drilled by one man in about half the time required by two men with the old double jack-hammers. The mechanical sledge weighs eighteen pounds, and because of the attached springs is not harder to swing than the three and a half pound single jack



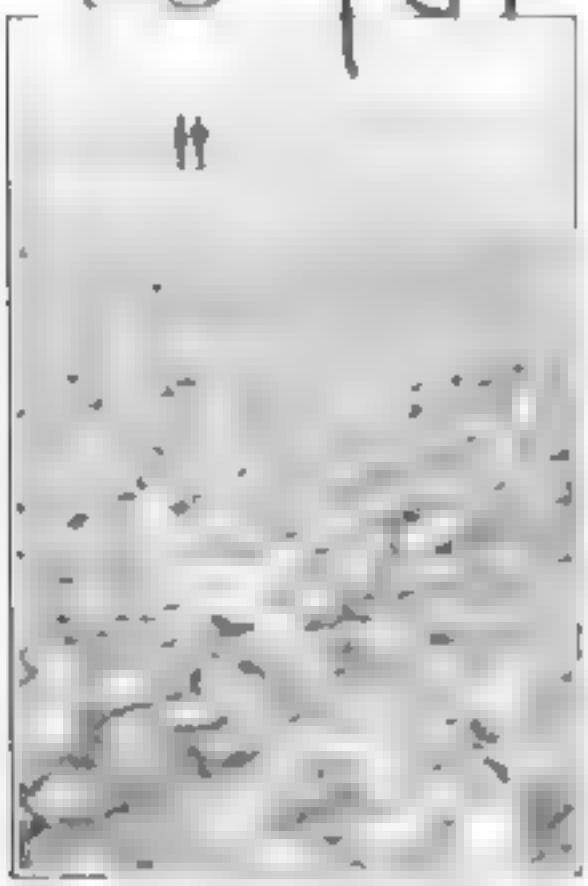
A Million Dollars Lost if This Lamp Goes Out

SAILORS rely absolutely on the fact that the ships and buoys tended by the U. S. lighthouse service will be in position with their lights burning under all conditions of weather and sea. It is rare indeed that their confidence is misplaced, and yet a buoy of the type illustrated [illegible] supplied with fuel [illegible] The crew is filling the tanks with compressed acetylene while they [illegible] which will give a ten-second flash every minute for the next twelve months, and if their work is not well done it may mean the wreck of a ship worth a million dollars.

Acetylene is but one of the many fuels used for illuminating the beacons along the coast of the United States. The principal source of light is the kerosene-oil-wick type of lamp. Then comes the oil vapor lamp using vaporized kerosene oil with a mantle, and in special instances even electric arc lamps and incandescent bulbs have been adapted for use in lighthouses and light-ships.

Every Pebble a Hemisphere of Ice and Life

ON the beach in winter alternate thawing and freezing may create surprising [illegible] more faster [illegible] where [illegible]

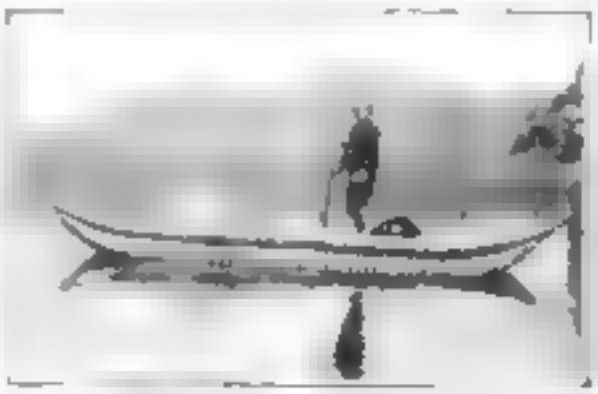


Frozen snow clinging to the pebbles gives a weird effect to this rock-strewn beach

turbed by waves, the water from the melting snow cuts away the depressions, leaving the packed snow on the pebbles in the form of hemispheres.

Curiously enough, these ice worlds are swarming with all kinds of germ life. Snow collects millions of germs in its folds, and these are present in the deposits on the pebbles.

After the snows of winter have each left their quota of bacteria in these shallow depressions along the shore, the spring sunshine brings the germs to life. Spores of plants as well as germs are deposited from the air by falling snow and rain, thus making of any beach a swarming hive of life



Primitive Canoe Built of Inflated Skins

CRAFT of this type are in general use on the rivers of Peru and the interior of South America. They are built of inflated skins protected by a covering of reed mats lashed into [illegible] like the new balsa rafts carried by our [illegible] modern liners.

Bulges on Cruiser's Sides Protect against Torpedoes

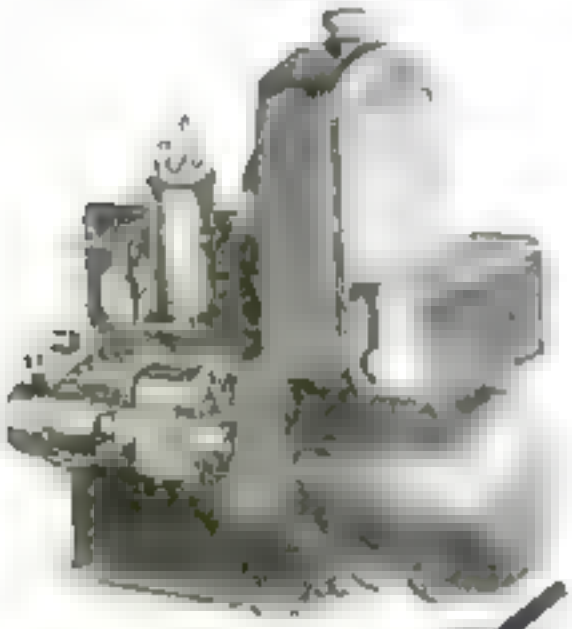
IN the British navy, where they were invented as a protection for cruisers against torpedo attacks, these bulges are known by the picturesque term of "blisters."

This particular illustration shows H. M. S. *Effingham* with one of the blister swellings under her waterline. The white fin along the side of the "blister" reduces the skin resistance of the bulge and enables the ship to make better speed.

In construction these bulges are formed of a series of crosswise girders, which provide a cushioning effect in the event of a direct hit from a torpedo or the sudden shock of an aircraft bomb exploding alongside.

It is evident from published plans that the powerful Japanese battleships, *Kaga* and *Tosa*, described at length in the November Popular Science Monthly, are to be equipped with these unique protective blisters.

Power House Starts when Light Is Turned On



ABOVE is shown a [illegible] plant which [illegible]

enough to comprehend when it is learned that turning on the light causes the storage battery to discharge through the small motor, mounted on the side of the unit. This motor starts the gasoline engine, like any automobile self-starter. As soon as the gasoline motor has reached a certain speed the small motor which served to start it is automatically cut out and the circuit to [illegible] turned [illegible] is also broken temporarily.

The generator entirely encased by the drum shown in the right of the picture, then begins functioning and delivers the power necessary for lighting your light up to the limit of the power of the unit, which is 1500 watts.

As soon as the current begins flowing into the line, it also flows into the starting battery, so that it will always have sufficient power to start the unit when you turn the switch.

Great changes in the load are followed so rapidly by the governor, that it is almost impossible to notice even a momentary flickering of the lights.

Ventilated Apartments Are the Style for Song-Birds

MANY songbirds of migratory habits will not go South in the winter if they are provided with a warm, comfortable nest and plenty of food. The Department of Agriculture has repeatedly demonstrated the advantage of using birds to protect the garden, but bird-houses suspended in the hot sun in summer and with no provision against the cold of winter are nothing more than slaughter houses.

The construction of the bird-house built by Edwin H. [illegible] of [illegible], New York, is almost ideal. It is a "ventilated apartment." An air space around the nest chamber and under the roof prevents the accumulation of heat in summer and retains enough animal warmth to keep the nest comfortable in winter. The inner chamber is formed of thin, spongy wood so that the moisture it absorbs will help keep the house cool in summer. Scientific calculation shows just how deep to make the nest cavity and how large to make the entrance to attract the species desired.

Fast Grinding Compound now Used for Bearings

QUICK action in fitting bearings is secured by a new bearing-grinding compound in which a 90 per cent bearing surface can be attained in brass and anti-friction metal after from two to twenty minutes of grinding. Crankshaft bearings averaging 15 per cent surface ground up to a 90 per cent bearing area in twenty-five minutes. After prolonged testing the shaft used throughout the trials showed no appreciable wear.

Although the compound is very fast-cutting, since the time saved runs from 75 to 100 per cent, it is not a grit or carborundum compound. The active principle seems to be a mixture of pulverized natural feldspar, sodium carbonate, cal-

A car [illegible] bearing [illegible] minutes of grinding is the accomplishment of this rapid acting abrasive

cium oxide, lampblack, and oil. Whatever the formula, it produces a better bearing than is possible by scraping methods, for these leave numerous high spots which make it necessary to take up the bearing as they wear down, whereas a ground bearing has a continuous surface to start with.

ONE of the very simplest and safest methods of fireproofing dress materials of linen or cotton consists in sizing them with a starch compound composed of 30 parts of sodium tungstate and 20 parts of borax dissolved in water and mixed with 50 or 60 parts of starch. The compound will not injure the fabric.

House-Moving in the Philippines

WHEN a Filipino moves to the next town he calls in half a dozen of his friends to help him. They pick up his house on their shoulders and carry it bodily to the new location.

Dirigible Directs Land Traffic by Radiophone

© Kadel & Herbert

S[illegible] were able to see the pr[illegible] and by relaying their orders [illegible] to the truck stations [illegible] that traffic was dir[illegible] the ground [illegible] are illustrated, everything 2,000 feet in the air. The traffic [illegible] was kept running smoothly

Baby's Bath with All the Latest Improvements

A COMBINED bath and dressing-table for the baby, which gives mother the opportunity to bathe him in the bathroom without carrying water or stooping, is recommended by physicians and nurses expert in the care of babies. It is made to fit over the regular tub, and when not in use folds out of the way against the wall.

This improvement is one of many inventions that are beginning to take the backache out of woman's work. The bath and the table are so high that there is no need to bend over when washing or dressing the child. The bath itself can be filled by a hose from the usual faucet. The apparatus takes the drudgery out of baby's daily bath and makes cleanliness a happy achievement.

Animal Life in the Sky

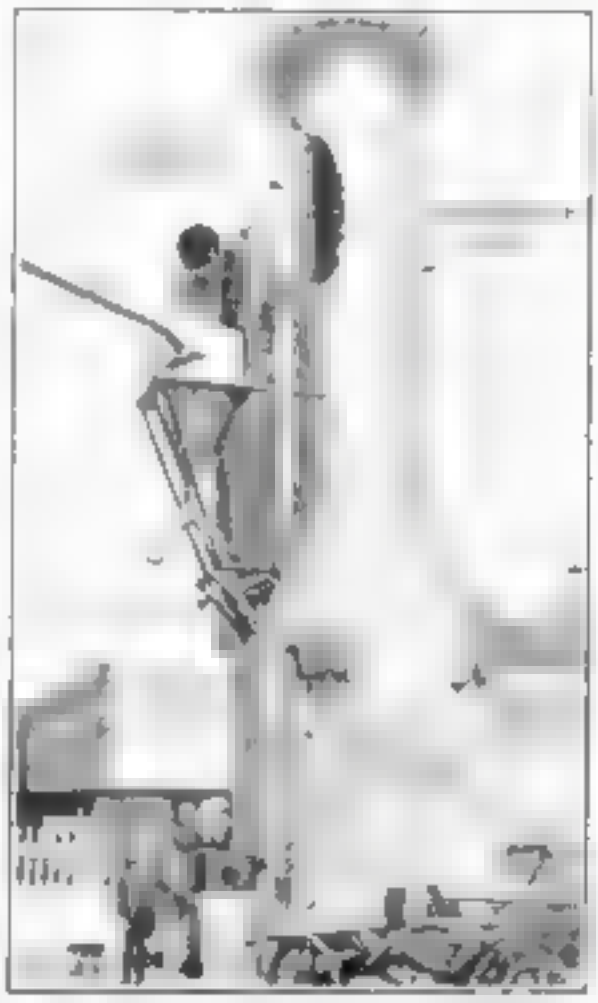
EXAMINATION of many specimens of meteorites has revealed the presence in them of living organisms. On being placed in the laboratory under suitable breeding conditions, the samples came to life and multiplied.

Further study of these micro-organisms will go a long way in verifying the claims of certain scientists as to the animal life existing in other worlds.

Wind Creates Natural Draft for Sawdust Incinerator

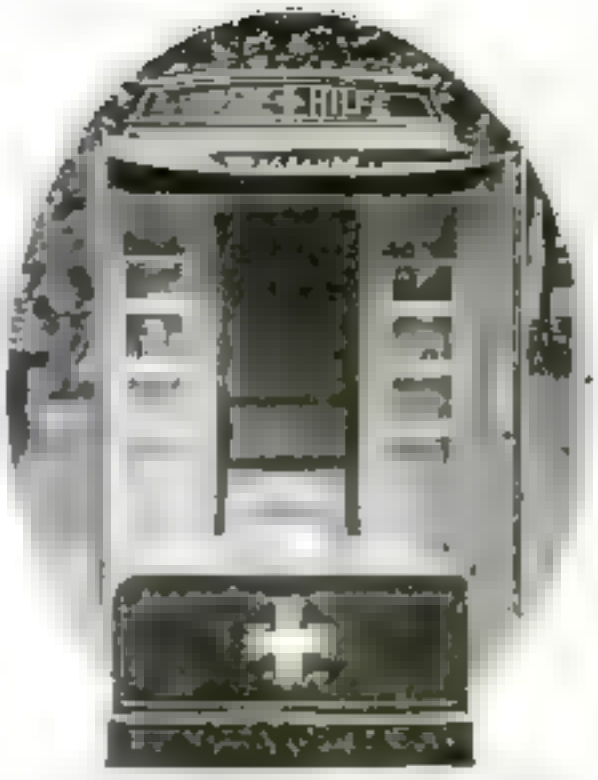
IN this improved sawdust incinerator, wind blowing from any direction is used to create a forced draft by its passage between the baffled openings and outlet holes in the conical section of the stack. The air also cools the exterior shell so that hardly any warmth can be felt on the outside, even when the sawdust is burning full blast.

There is an inner stack of brick, with upper and lower inlets on the sides that register with those in the outer concrete



Openings pointing every way insure sufficient draft whatever the direction of wind

shell. All these inlets have baffled openings so that the air admitted to the stack is under control by the fireman. Sawdust is supplied to the incinerator automatically through the blower shown at the left.



Street Stations for First Aid

SMALL first-aid stations completely equipped with medicines and materials likely to be needed after a street accident, have made their appearance in some of the cities of Europe.

The cabinet is operated like an American fire alarm. When an accident occurs the policeman breaks the glass over the little door in the center of the panel and the cabinet opens automatically. Inside are a stretcher for serious cases, drinking water, tourniquets, antiseptics, and bandages needed for taking care of an injured person while awaiting the arrival of the ambulance

Separates Liquids from Soil

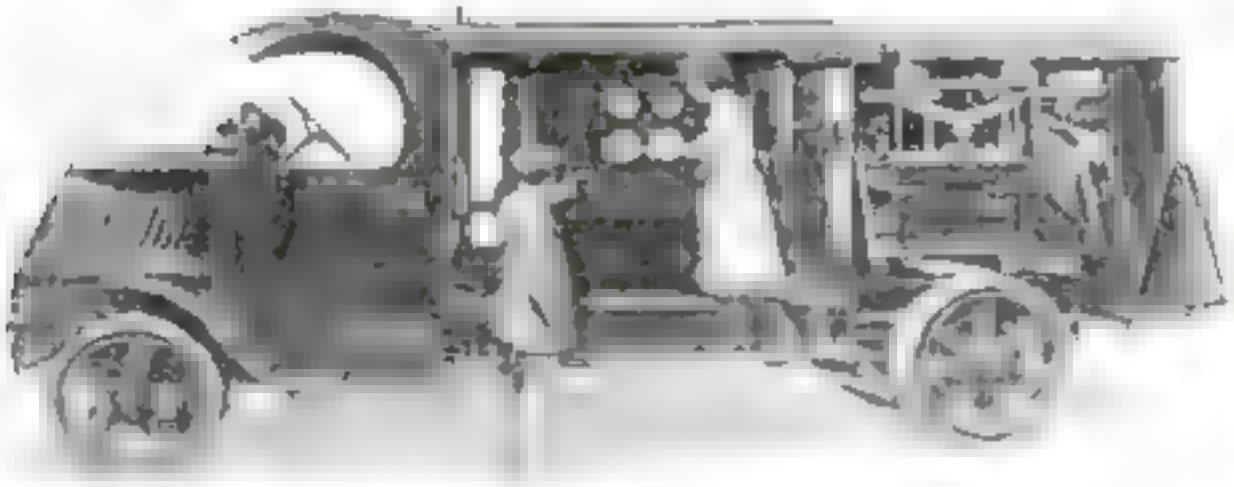
BY the use of a centrifugal separator of unusual power, M. S. Anderson, of the Bureau of Soils, has already demonstrated that the salts occurring in soils are more complex than has been hitherto believed.

The separator was designed to expedite the analysis of the soil of [illegible] and the

The Bureau of Soils is using a cream-separator to separate liquids from soil during tests

earth that is to be used for building roads. With a maximum speed of 17,500 revolutions a minute, the machine separates the liquids from the solid particles of the soil with unprecedented rapidity, permitting analysis in wholesale quantities.

Movies Now Carry Their Own Power Plant



A powerful water-cooled gas-engine on this truck drives a generator that produces power for the searchlights used in making motion-pictures

THE majority of motion-picture films are produced "on location," which may mean a beautiful spot just outside the studio door or it may signify a thousand-mile trip to a mountain top or a desert waste. Some of the long-on views must be taken at night, necessitating some source of current for the numerous flood- and spot-lamps used. Self-contained power plants on trucks are used for this purpose.

The illustration shows a portable power plant from the Ince studio. All control switches with indicating meters are placed directly back of the driver's seat. Behind the switchboard is the powerful gasoline engine that drives the generator. The radiator used to cool the circulating water is on the rear with a fan back of it to create a cooling breeze over the engine cylinders.

Centrifugal Force—the Energy that Snaps the Whip and Dries the Clothes

How terrific destructive power is usefully applied in industry

Centrifugal force really killed Goliath. When David swung the primitive sling around his head it was centrifugal force that gave momentum to the stone

"GO Slow Dangerous Curve Ahead" warns the sign by the roadside, but if it were made to say what it really means, it would read, "Look out for centrifugal force," for that is the mechanical principle which causes most of the accidents along the highways.

Centrifugal means "the tendency to fly away from the center" You will remember that Newton's second law of motion is to the effect that matter always seeks to move in straight lines. When anything moves in a curved or a circular path, it does so under protest It is always trying to break away and follow its inclination to travel in a straight line. The simplest illustration of this is the boy's toy sling

You remember how you used to whirl a stone around your head on the end of a string and how far it would travel when the string was released. The cord compelled the stone to move in a circle, but it was always trying to fly at a tangent to the circumference and did so when released.

But centrifugal force, like fire, is as helpful as it is dangerous. Once it is allowed to become unmanageable, it will wreak disaster, but if properly applied, it is found to be one of the most useful forces in nature. With the aid of friction it moves the automobile along the road. As used in the steam-engine, it even keeps a check on itself, for the engine governor operated by centrifugal force is the only thing that keeps the engine flywheel from speeding up and whirling itself to pieces by centrifugal force

It Made White Sugar Possible

Before the application of centrifugal force pure white sugar was unknown. Batteries of centrifugal separators now form a vitally important part of the mechanical equipment of every dairy and chemical plant. Without its use it would take days instead of hours to finish our laundry. The phonograph and the passenger elevator would be impossible, and it would be as dangerous to run a steam-engine as to manufacture dynamite.

By recalling again the toy sling, it is easy to see that the amount of centrifugal force will vary directly with the weight of the wheel or other body being revolved and with the speed at which the body is being rotated. These unchanging properties of centrifugal force are what makes it so valuable. Suppose, for instance, you want an engine to turn over at a constant rate of speed, not necessarily a huge engine but a small one like the spring engine that drives your phonograph. Or suppose you merely want to make sure that the engine will not speed up above a certain point such as the motors operating elevator hoists. How can a governor be designed to do this? A governor that will be simple and absolutely positive in its action? Only by taking advantage of centrifugal force.

In an engine governor, two hinged arms attached to a revolving spindle are directly geared to the flywheel. When the engine is at rest, the force of gravity makes the arms hang down, but as soon as it begins to turn, centrifugal force impels the arms to fly away from the axis of the spindle. They rise up against the force of gravity, and the faster the spindle turns the nearer the arms will approach the horizontal. The arms are connected with a lever controlling the throttle-valve, which is slowly shut as the flying arms of the governor lift. The faster the engine turns, the less steam is admitted to the cylinders, and if the speed approaches the danger point, the governor will shut the steam off altogether. When the engine slows down, the arms fall, and more steam is admitted. In this way the speed can be kept constant

Governors are so designed that the steam will be shut off if they break, since without some device to prevent the speed from increasing, a steam-engine would revolve so rapidly that the centrifugal force developed by the flywheel would break the engine to pieces. In this way the engineer prevents such an accident by a clever use of the very force that causes the possibility

Another general type of centrifugal machine takes advantage of the fact that at constant speeds the amount of centrifugal force depends on the weight of the substances revolving. You remember that you can swing a pail of milk round and round over your head without spilling a drop, because centrifugal force holds the milk against the bottom of the pail. Now, if you could swing that pail fast enough, the skim milk would collect in the bottom because it is heavier than the cream. [illegible] centrifugal separation

For Separating Liquids

Milk, oil, or paint, it makes no difference what the substances [illegible] whenever two liquids differ slightly in weight we can separate them by revolving the mixture rapidly in a bowl and drawing off the heavier mixture from a spout near the circumference and the lighter one from an opening closer to the center By changing the position of the spouts, we can get just the percentage of mixture we please. By slight variations in speed and adjustment, for example, a cream

There is an interesting paradox in steam-engine design. Centrifugal force is used in the governor to prevent the engine from running away and destroying itself through centrifugal force exerted on the revolving flywheel The illustration above pictures the chaos in an engine room when the governor fails to act and allows the engine to tear itself apart

Illustrated above is an actual scene of what happened to a plant when an engine got out of control

In every modern laundry centrifugal force dries the clothes. This metal basket is whirled at a high velocity, throwing the globules of water to the outside through perforated holes

separator will turn out a cream so thick that it can scarcely be poured, or the thinnest of skim milk. In the same way water and dirt can be cleaned from oil more efficiently than it can be removed by the most elaborate straining.

Many modern dryers are also centrifugal machines. In sugar-drying machines the bowl has an inner lining perforated like a sieve. The moisture is forced through the material and driven out through the holes, while the solid substances are held against the side of the walls. As the machine starts to slow down, the moisture trickles off, and a few moments later the dry sugar is allowed to fall through the bottom of the bowl into a conveyor waiting to receive it.

Before the introduction of centrifugal machines, in 1860, sugar was light brown instead of white in color, as it was impossible to strain off all the molasses. The separation is essentially an accelerated screening process, which is the same in principle as filtering by gravity, but centrifugal force in the usual machine is from four hundred to six hundred times as powerful and the drying process is almost unbelievably thorough and rapid. In one sugar refinery four centrifugals operated by two men purged, washed, and dried thirty-five thousand pounds of sugar in one hour and three quarters. One dryer will handle three hundred pounds at a load and since it requires only thirty-five seconds to stop or start the best machines, from twelve to fifteen charges can be treated in an hour.

Virtually all drying of chemicals is done by centrifugals, since the machines can [illegible] any granular and fibrous matter [illegible] liquid to seep through. For the reason [illegible] laundries use centrifugals for drying clothes. It is a scientific application of the method used by a dog when he shakes the water out of his coat, and you can imagine that after being "shaken" at over three hundred revolutions a minute the clothes are as dry as if they had been hanging in the sun for hours. The clothes are held firmly against the sides of the basket, and there is no tendency to break or weaken the fabric.

Freeing Compressed Air from Moisture

In some industries centrifugal separation is accomplished without the use of whirling machinery. In freeing compressed air from moisture, for example, it has been found that sending the air through a specially designed pipe elbow, which forces it to whirl in a helical path around a central core, will strain out the water perfectly. The moisture is so much heavier than the air that it will not take the turn as readily. Centrifugal force throws it out of the path of the air against the wall of the pipe, from which it trickles down slowly into a receiver.

Cream-separators would be impossible without centrifugal force. It is this force that draws the cream from the milk and carries it to the top of the bowl, where it drops by gravity into the cream-can

An elaboration of this principle is used in Norway to separate the nitrogen and oxygen of the air. These gases are almost the same weight, but although the relation between their densities is as 14 : 16, when they are forced to turn an elbow at high speed, the heavier oxygen will be thrown against the outer wall. This demonstrates the great delicacy of centrifugal methods of separation.

There is again the danger from centrifugal force that lies in wait at the curves along the highways, for a speeding automobile tends to keep moving in a straight line, and if it be turned too sharply, centrifugal force will lift the inner wheels from the road, or even turn the car into the ditch. The "Go Slow" sign at the turn is really a warning against centrifugal force.

How To Be Measured for a Set of Artificial Teeth

A GAGE for measuring artificial teeth has been devised by Dr. William C. Darbey, of Shanghai, China. It consists of a horizontal bar that is rested on the head of the patient, and two depending bars, each of which carry measurement markings on their lower portions.

These bars are pivoted to the horizontal bar, and one of them may be slipped along this member to adapt the instrument to persons having faces of different degrees of fullness. When these bars are brought into alinement with the jawbones of the person desiring artificial teeth, a pointer indicates the proper size on a scale. The scale is marked with the proper size and form of teeth required for every conformation of skull and jaw, so the dentist is relieved from all uncertainties in the prescription.

Tropical Lineman Has Hard Job

CERTAIN parts of South America are the habitat of a large spider that weaves its web around the telephone wires strung on the cross arms of poles. The spider is enormous and its web is heavy and of a tough texture.

The telephone companies were much perplexed when in the late evenings and nights frequent short circuits tied up their lines. After a time they discovered that the trouble arose from the heavy spider webs. When the sun was out, the webs were dry and there was no trouble, but at night, when the webs were covered with dew, short circuits occurred. The only remedy is constant brushing away of the webs from the telephone wires.

Submarine Mine-Sweeper Enters the Movies

BUILT to cut wire entanglements and sweep mines in the war, which is the explanation of the [illegible] on the

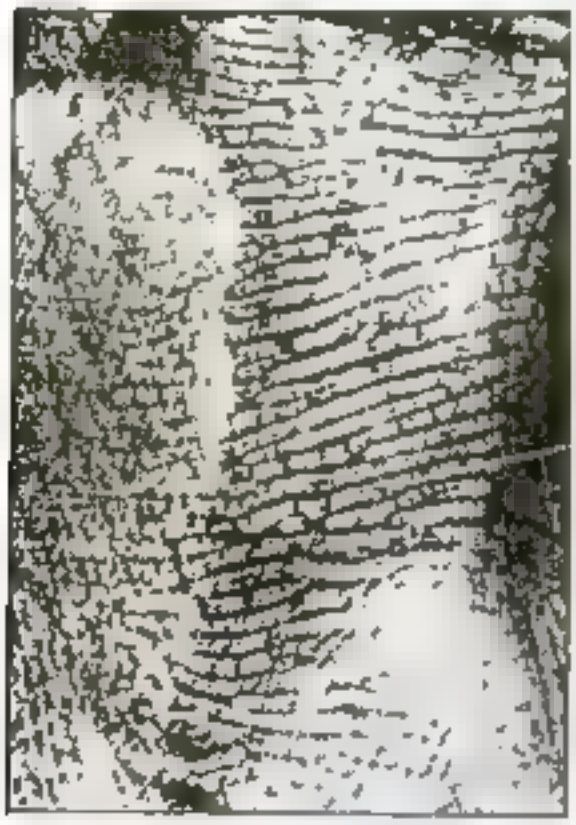
Used by the Germans during the war, this mine-sweeper has become the property of a film company

runners, this German submarine sled is now the property of a moving picture concern. It is as large as an airplane, and moves along the bottom of the sea under its own power.

The driver is encased in a diver's suit, and the invention affords an unequalled opportunity for taking pictures of the aquatic life beneath the surface of the sea.

Identifying Criminals by Their Pores

A pore-print taken at the scene of crime



A pore-print taken from the suspect

Pore-prints are as infallible as finger-prints. The arrows point to a characteristic in each print that positively identifies the suspect. The ridges at the arrow-heads are similar in alinement and each contains the same number of pores

NOWADAYS, the ease with which criminals may be identified by finger-prints is well known. But sometimes the finger-prints are blurred, half wiped out by the thief, or only a very small part of the finger-tip is shown. In these cases, which are becoming more frequent as the under world recognizes the danger of leaving finger-prints on the scene of crime, this method of identification is impractical. In order to identify the criminal from the smallest and most fragmentary imprint a French scientist has perfected a positive method of identification through the individuality of the innumerable sweat-glands on the fingers.

In an enlarged photograph of a finger-print the orifices of the sweat-glands appear as small black dots upon the convoluted ridges that make up the imprint. Scientists have discovered that the number of these glands, their arrangement, and position, is different for every individual, and like the pattern of the finger-print itself, never changes during life. It is clear then, that here is a scheme of identification that may be employed when the usual finger-printing methods fail.

Even the shape of the mouths of these glands varies. Usually it is a perfect circle, but often the prints will show an oval, a triangle, or an ellipse.

The usual method of taking finger-prints, which employs printer's ink, is not suitable for showing these pores, as the ink is somewhat greasy and fills them completely. Graphite and lampblack have the same effect. Pore-prints should be taken with a light powder such as copper oxide or white lead.

A little of this powder is blown on the finger-prints discovered at the scene of the crime, and then they are photographed by a camera, which enlarges the print several hundred diameters, so that the sweat-pores appear from six to eight millimeters in diameter in the print. The same method is taken to get a finger-print from the man suspected of the crime, and from this point on the identification is simple. It is only necessary to compare the number, the position, and the form of the visible pores. If these correspond exactly, the man is guilty, without a doubt.

The method is not confined to the pores of the fingers, since the arrangement of the glands on any other portion of the body is equally characteristic. In a recent police case in Lyon, a thief took the precaution of wearing gloves, and left no finger-prints at all. The police discovered, however, that he had rested his forearm on the marble top of a table. A print was taken, and a positive identification effected by an examination of the pores.

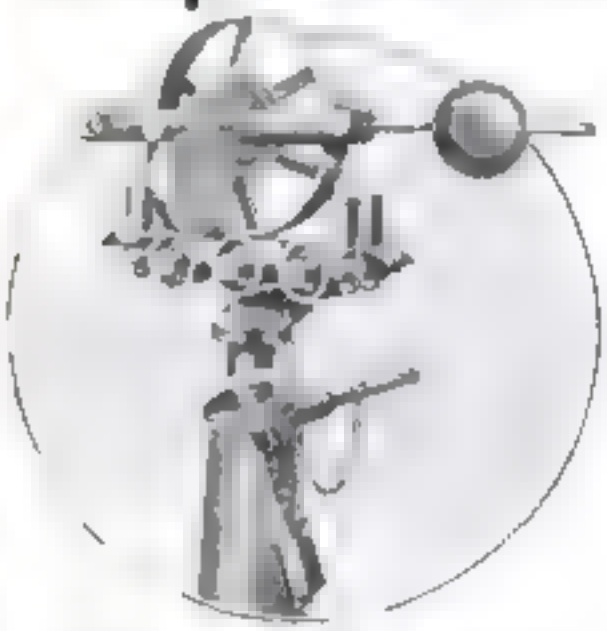
The criminal of today has indeed to "watch his step" to elude the fast-closing circle of identification tests that the modern criminologist has at his command.

This Machine Measures Wire of Any Size

IN measuring wires and cables correctly it is essential that they pass through the machine in a straight line, and that the measuring wheel be of ample size and offer no resistance when it is set in motion. These features have been embodied in the invention depicted, which will measure any wire up to cables two inches in diameter.

Guide rollers front and rear of the press wheel keep the wire from sagging, and the measuring wheel is four feet in circumference.

Both the wheels run on roller bearings, and may be spun with one finger while a pressure of one hundred and ten pounds is exerted on the wire.

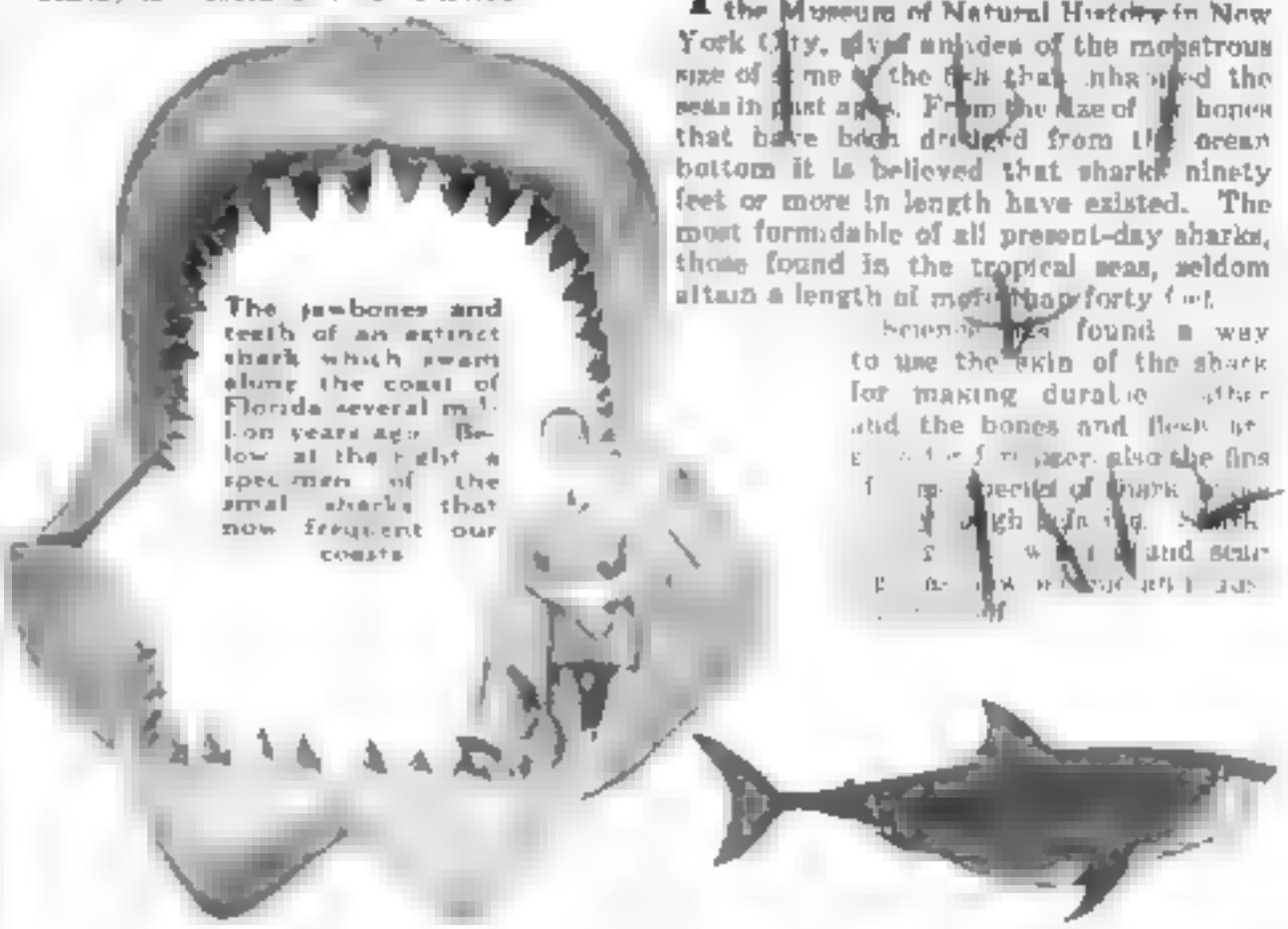


Cables up to two inches in diameter can be measured with this machine. A dial automatically indicates the cable's length

The pressure is adjusted by means of a sliding weight and rod placed on either side of the swinging cradle. The resetting of the dial is accomplished by means of a disengaging mechanism, and the height of the wire from the floor may be varied from thirty-four inches to four feet.

Fossil Shark Could Swallow Small Whale

Courtesy American Museum of Natural History



The jawbones and teeth of an extinct shark which swam along the coast of Florida several million years ago. Below at the right a specimen of the small sharks that now frequent our coasts

THIS jawbone of a fossil shark set up at the Museum of Natural History in New York City, gives an idea of the monstrous size of some of the fish that inhabited the seas in past ages. From the size of the bones that have been dredged from the ocean bottom it is believed that sharks ninety feet or more in length have existed. The most formidable of all present-day sharks, those found in the tropical seas, seldom attain a length of more than forty feet.

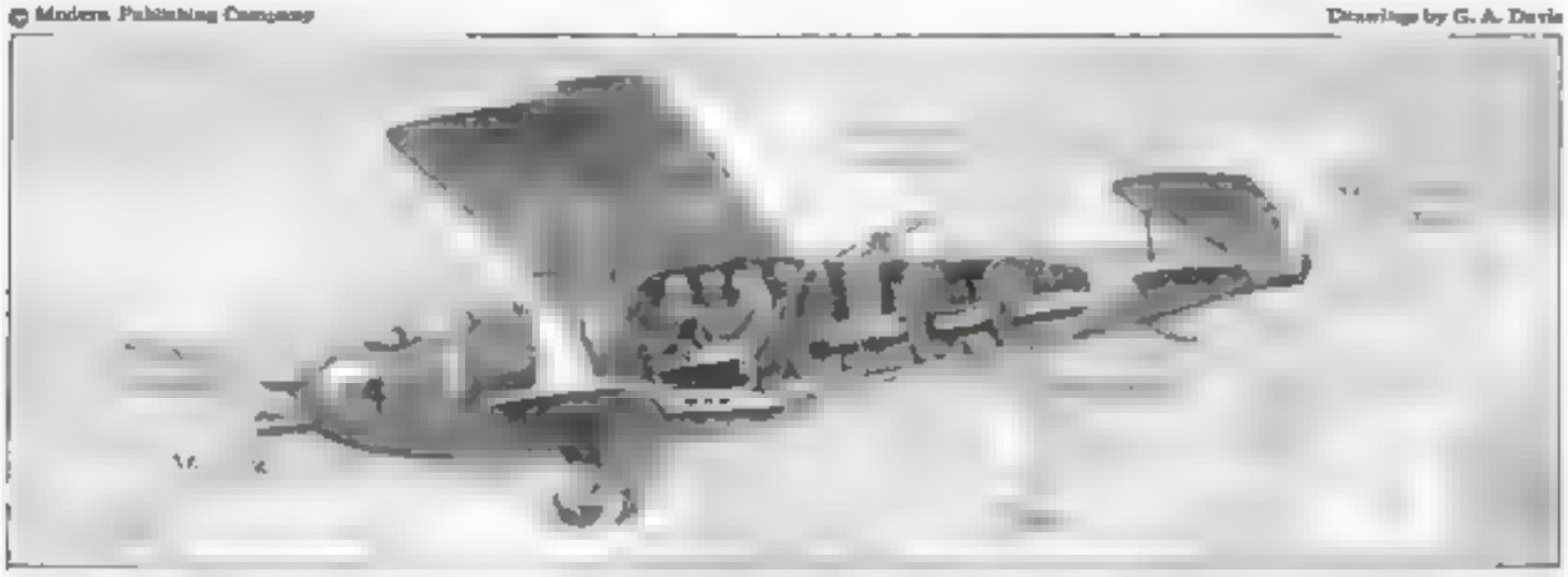
Scientists have found a way to use the skin of the shark for making durable [illegible] and the bones and flesh [illegible] also the fins [illegible] and scar[illegible]

England Designs Battleplane to Carry 12-Inch Gun

Weapon with no recoil is to be built into fuselage

By P. J. Risdon, *English correspondent of Popular Science Monthly*

© Modern Publishing Company Drawings by G. A. Davis



Huge battleship of the air equipped with one twelve-inch gun extending from front to rear and built into the plane as part of the fuselage, are being developed in England

DREADNAUGHTS of the air carrying guns as large as those of a modern battle cruiser comprise the latest aerial development that follows close on the heels of the recent battleship-bombing tests in England and America. The gun used is the "no recoil" Davis gun on which experiments were being conducted during the later days of the war. It is the unusual principle of the gun and not the construction of the plane that makes the combination possible.

When an ordinary gun is fired, the enormous explosion that expels the projectile reacts on the gun itself with a resultant force known as the "recoil" or "kick." The heavier the shell and the more rigid the mounting, the greater the recoil.

Knowing this, it is obviously impossible to fire a rigidly mounted twelve-inch gun from an airplane in flight without totally destroying the plane. But by constructing the gun with the breech in the center and open at both ends, and filling the rear end of the barrel with finely divided material such as birdshot, the gun may be fired with no apparent recoil. The recoil is present, but it is expended in driving the fine shot from the rear end. This is the idea of the Davis gun. The range of the projectile is considerably reduced with a rifle of this design, but that matters less with a plane than with battleships and land forts.

Elimination of the recoil allowed the inventors to cut down the thickness of the gun walls and especially the rugged construction of the breech mechanism. The weight of the twelve-inch gun thus reduced makes possible its use on airplanes.

As at present designed, the airplane to carry the Davis gun will be of the monoplane type with cantilever wings stayed only from below to avoid all outside wiring. The gun itself will be mounted inside the fuselage and will extend from end to end of the streamline body. Any backwash of flame and gases after the gun has been fired will be overcome by fitting a metal nose to the machine and protecting the gun layer in the cockpit by a flash-shield similar to those used on British destroyers.

Strange to say, the big twelve-inch gun will be aimed by means of a machine gun mounted in front of the gun layer in the cockpit and firing tracer bullets.

Although under normal conditions the pilot has complete command over the plane, it will be necessary to transfer this command to the gun layer during action. The duties of each member of the crew will be correlated by a complete system of telephonic communication.

Just how many tuckers such a [illegible] carrier [illegible] a plane has not yet been settled [illegible] or more strategic for a [illegible] gross.

It may be that the weight of the gun will be such that the supply of heavy shells will be limited, in the same way that bombing-planes are restricted in the number of bombs that can be carried. But further development along these lines may lead to an aerial fighting unit that will demand a complete reversal of tactics when "the next war" is upon us.

[illegible] development in the [illegible] not

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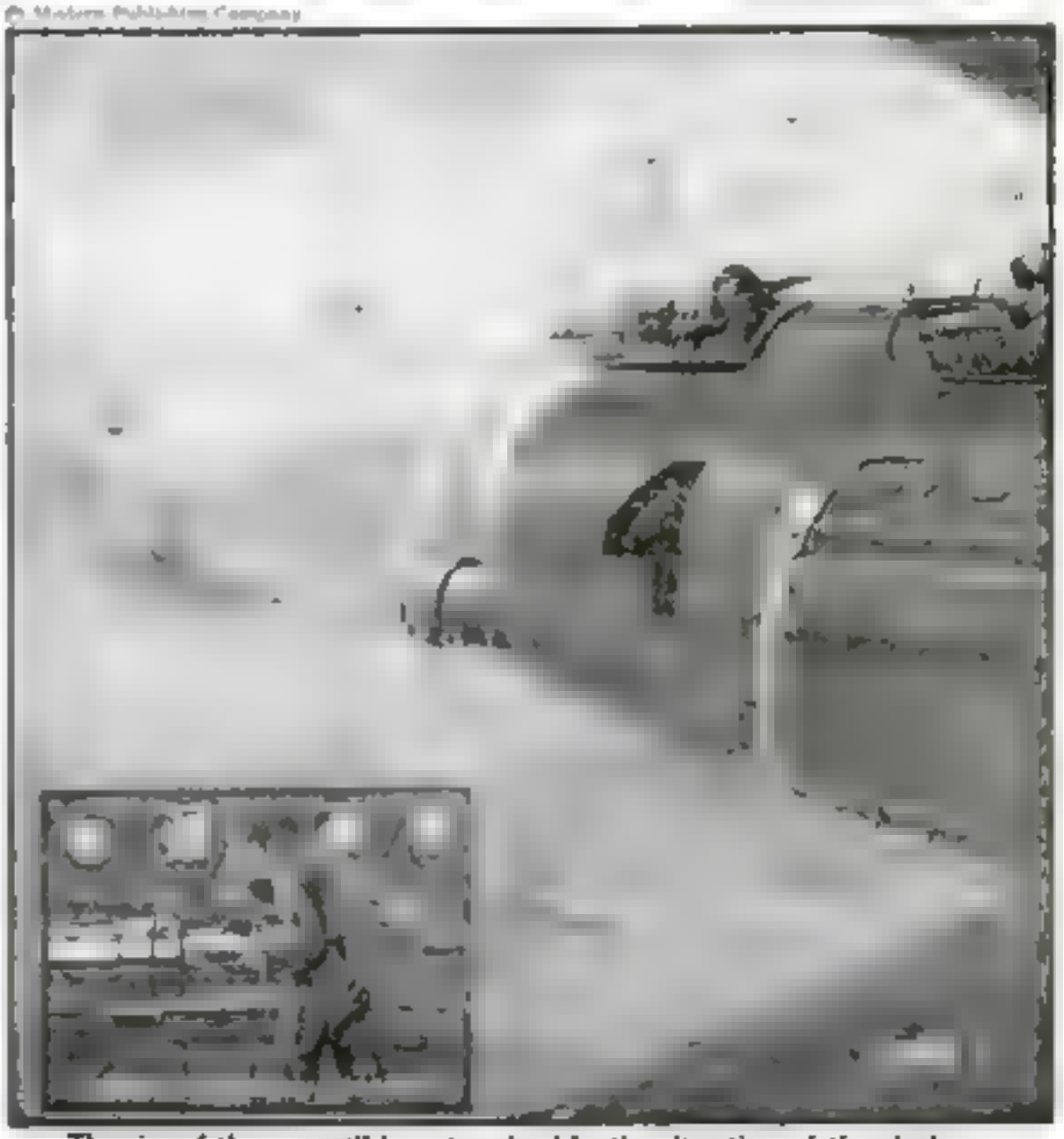
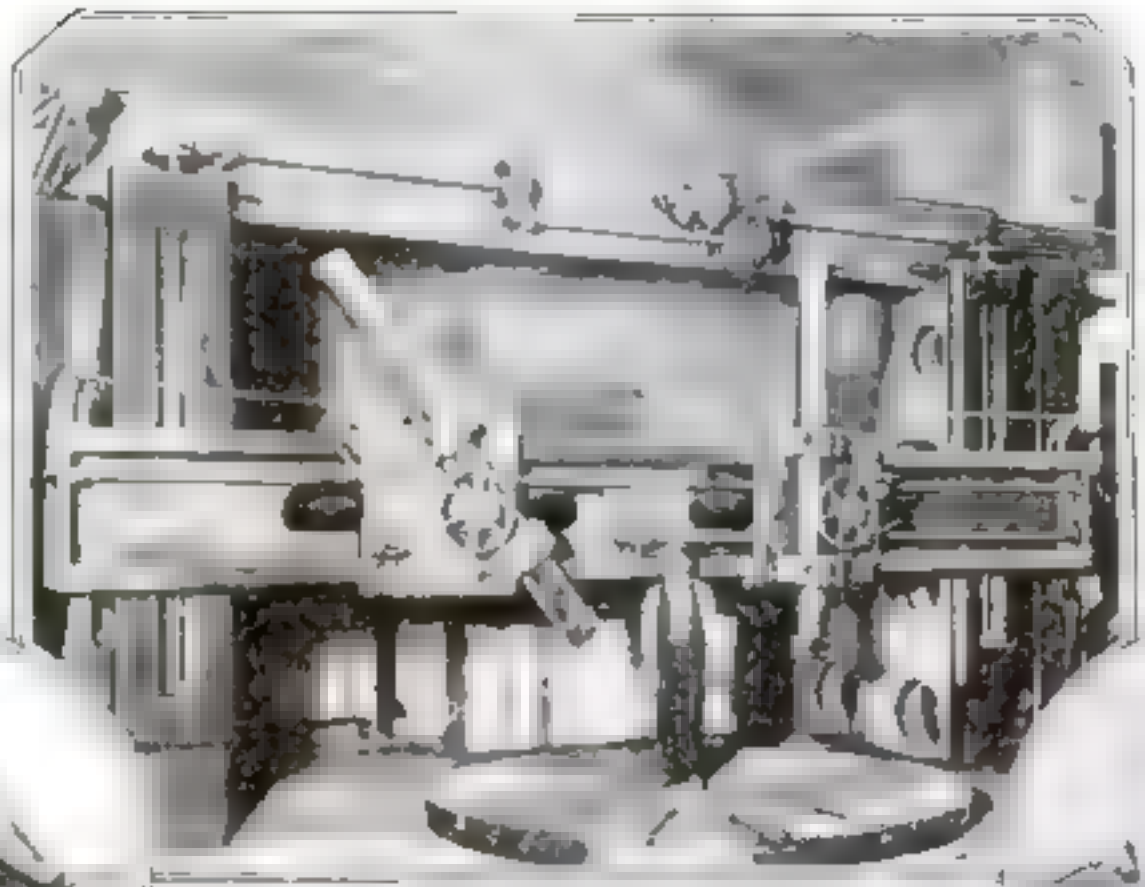


The aim of the gun will be determined by the direction of the airplane, but the accuracy will be checked up by a machine gun firing tracer bullets. The insert shows the gunner placing a shell

Tools and Machines that Are Money-Savers in the Shop

Portable drill

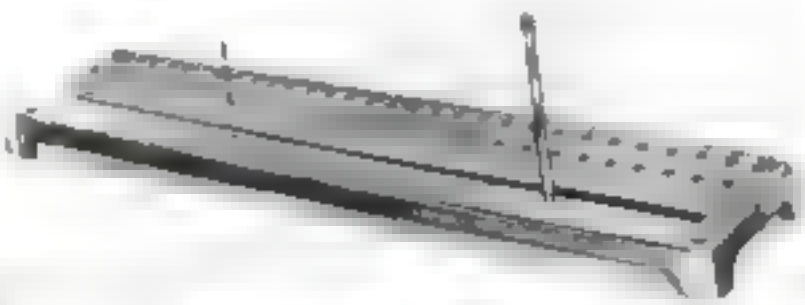


Folded this device is an ordinary S wrench

Vertical boring and turning mills having a

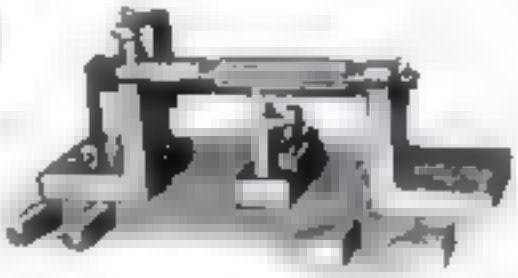
By generally adopting the

Blades



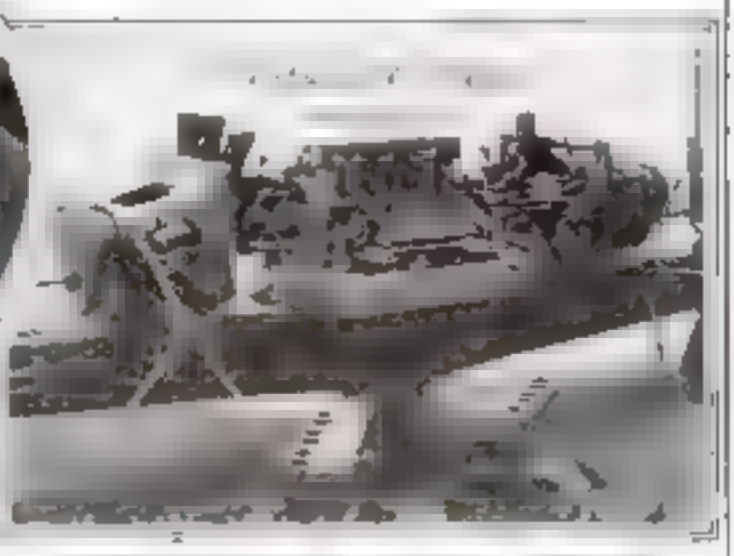
Fitting either flat or round terminals

Keeping drills and gages



Machine and hand equipment

Garage man who has



This portable

The

Remote Control of Clay-Pigeon Traps

By Capt. Edward C. Crossman

AN automatic clay-bird trap that is entirely different from anything made in this country is revealed in photographs of the first trap-shoot held at the Halen See shooting grounds, near Berlin. In American parlance, an automatic trap means one that is set and pulled from the firing-line, the person in the pit merely loading it for each bird thrown, and also changing the direction of the trap from bird to bird.

A study of the battery of traps used at this big shoot develops the fact that the traps are made double with throwing arms both above and below. When one arm is forward or unset the other arm is set ready to be released.

In the tournament at Halen See, the traps were operated from the firing-point by a set of ten wires terminating at a control board similar in many respects to the signal-control system on a railroad.

It would seem that the spring tension on the arm throwing the "bird," helps to overcome the resistance of the spring of the unset arm and a slight additional pull would then drag the unset arm around to its set position, with the spring extended and ready to throw.

The two throwing arms, upper and lower, each with its spring, are thus apparently in a state of approximate balance of spring tension. Both operating on the same vertical pivot, when the upper arm, for instance, is released and is thrown violently around by the tension of its extended spring, the tension of the spring is sufficient to partly overcome the resistance of the lower arm spring, and a much lessened resistance resetting would be encountered. The reverse would be true when the lower arm was sprung.

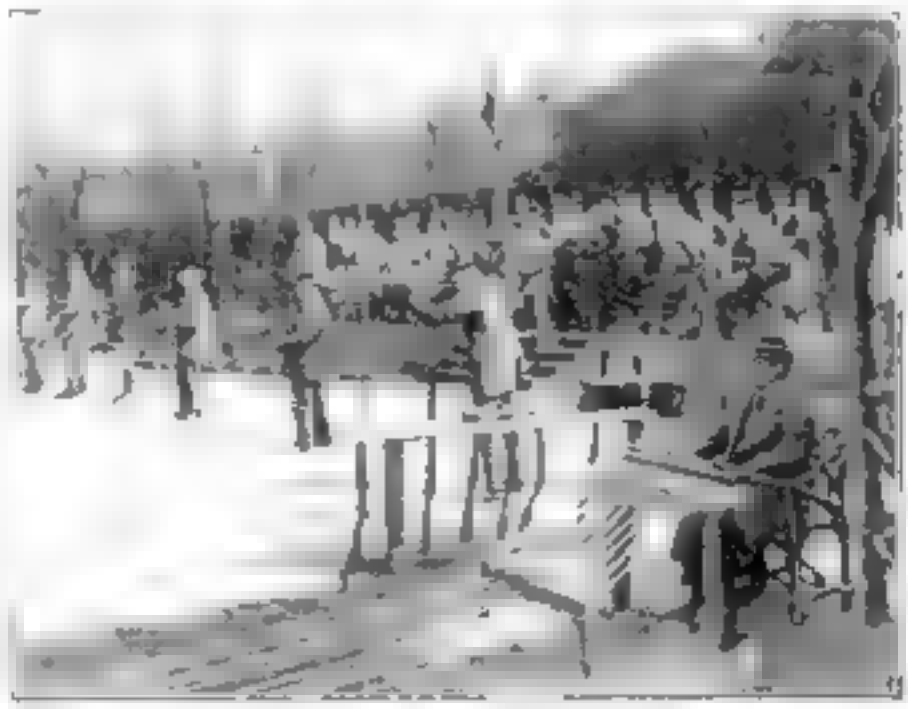
The wires running to the firing-point are both trigger and setting wires, the trapper having only to load the trap as is done with the American automatic device.

The game as played by the American sportsman calls for only one trap at a known point, but with the pigeon rising at unknown angles. The foreign trap-shooter, with his more practical idea of how to shoot clay birds, wants his targets to rise from unknown spots as well as to fly at unknown angles. He also keeps his gun below his elbow until the moment the bird appears.

At the Halen See shoot the German sportsmen used a battery of five or more traps, set a yard or more apart, thus covering a space of at least twenty feet, from any point of which the bird may appear. The trap to be sprung is optional with the puller, but the shooter does not know which of the five it is to be.

The man controlling the traps is placed close enough to the shooter to hear and act instantly upon the command of "Pull."

In the United States the traps commonly used fall into two classes, one of which is similar to those shown in the illustration, with the exception that the double-deck feature is absent. Up to the present time, the idea of controlling the traps from remote points has not been adopted here.



The shooter does not know which of the five traps will be released from this control board

Loading the automatic traps at the firing-pit before the match begins

Paper Pulp, Dyes, and Alcohol from Waste Corncobs

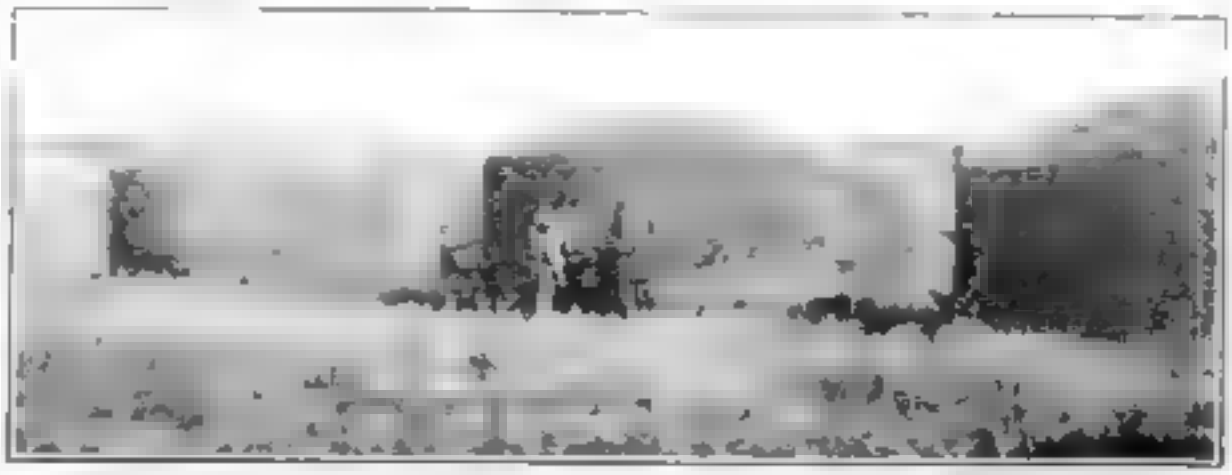
IOWA chemists believe they have found valuable products locked up in the lowly corncob. Bran, once a waste product of the milling industry, choking the streams that ran by the mills, is now one of America's most valuable breakfast foods. Corncobs may equal it and prove to be one of the Middle West's worth-while products.

Millions of dollars' worth of cobs that have decayed in feed lots during the last few centuries may some day be transformed into paper pulp suitable for a strawboard substitute. Some of the products that may be secured from cobs are acid tar, wood alcohol, pitch, charcoal, acetic acid, formic acid, and, lastly, furfural.

The Bureau of Chemistry of the Department of Agriculture has already succeeded in recovering furfural from corncobs, and experiments have demonstrated that it can be obtained in large quantities by certain chemical treatments. Furfural has been a comparatively rare chemical, and has been sold chiefly in small quantities for scientific purposes. The price is about ten dollars a pound, but specialists of the United States Federal Bureau advise that it can be manufactured from corncobs at a cost of from fifteen to twenty cents a pound.

Furfural's most important present-known use is in chemical literature, as an intermediate for dyes. A whole series of dyes may be prepared by interaction with various coal-tar products. Shades covering a wide range already have been made and tested.

The United States produces from two and a half to three billion bushels of corn annually. That means about twenty million tons of cobs. It is evident, therefore, that if all this waste product can be utilized, it will produce an enormous quantity of furfural, to say nothing of various other products.



Piles of corncobs on an Iowa farm, once wasted, but now awaiting conversion into furfural and other valuable chemical by-products

Another Scale Pest Makes Its Appearance

THIS time it is New Orleans and the surrounding territory that is the camping-ground for a new pest. It is called the "camphor scale," but it has no compunctions against other trees such as the citrus, oak, and fig trees.

Just how or when the pest got into the United States is not known, but observations of its speed in spreading has led entomologists to believe that it arrived during the past year. Camphor scale is well known in India, China, Japan, Porto Rico, and the Philippines.

All the Government agricultural forces are active in an attempt to eradicate the pest before it spreads.

Motion-Pictures Can Be Shown without Darkening Theater

A DAYLIGHT projectoscope has just been demonstrated before the French Academy of Sciences by the French inventor, M. Dussaud. The apparatus projects moving-picture films, stereopticon views, or even illustrations from a book into a well-lighted room. An improved condensing-lens and the use of

© A. N. Mirsoff

Pictures on the wall, ceiling, or floor in daylight are possible with this projectoscope

concentrating mirrors which focuse the image without the loss of light, permit projection without the necessity of darkening the auditorium.

The Chief of Air Service is informed that M. Berger, a Swiss, has invented a muffler for airplane engines which does not heat up nor reduce the power of the motor, while it will allow conversation in an ordinary tone of voice between pilot and passenger. The invention is similar to an automobile muffler with the addition of a small revolving fan at the rear which aids in cooling the exhaust gases.

Cow-Punchers Use Modern Mess-Wagon

ALMOST daily there crops up some new evidence of the versatility of motor-trucks.

During the round-up season the Pitchfork Ranch of Wyoming uses a truck to take the place of the old-time mess-wagon and, like that sturdy vehicle, it often travels for miles straight across country where there is not a suspicion of a road, following the cow-punchers.

The truck carries a complete camping outfit and delivers "all the comforts of home" wherever the boys of the outfit happen to be.

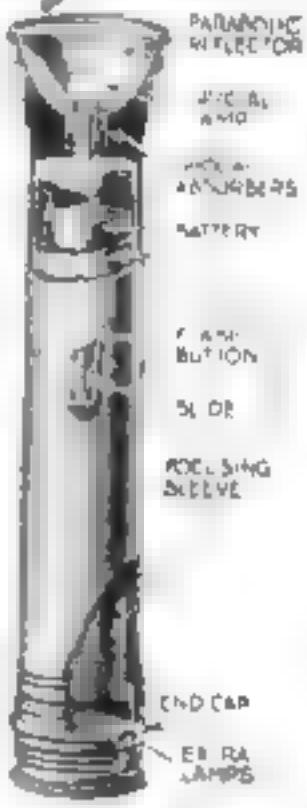
Safety-Pin for Milk-Cans

HERE is Guy S. Brewster, of Seattle, Washington, demonstrating the "safety pin" he has recently invented.

Thousands of cans of milk are spilled daily. Mr. Brewster devised a simple but positive lid-clamp of three pieces of spring steel, riveted together. The clamp slips over the top of the can, with the longer strip passing across the top. The shorter side strips grip the neck of the can.

New Flashlight Has Three-Hundred-Foot Range

SCIENTIFIC design of the reflecting mirrors and the location of a new form of electric-light filament enabled a flashlight to be put on the market which will throw a bright beam of light for three hundred feet about six times as far as a good flashlight generally carries. The reflecting mirror is made in the shape of a perfect parabola, so that all the rays leave the lamp parallel, and the bulb throws no shadow, so that every bit of the illumination is utilized.



An adjustable reflector makes possible a 300-foot range

By turning a screw at the base of the flashlight, the bulb can be moved back and forth inside the mirror. This movement, which takes the filament of the light away from the focal point of the parabolic mirror, makes it possible to throw a broad shaft of light for a short distance, lighting up a large area, or to produce a narrow beam which will render small objects clearly visible at three hundred feet. The lamp is already being adopted by many of the police departments throughout the country. The case is made watertight, and the light has been used in a pouring rain without short-circuiting.

Railway-Cars that Unload Automatically

THE illustration shows a new type of car used by a German mine. The swinging bottom of the car is released by a lever, which unlocks easily as the load pressure of the car acts horizontally, and the several gates of the swinging bottom have hook locks that open vertically. The [illegible] also returns the gates to the closed position and locks them.

Another type of the car is made in which the gates close themselves after dumping, and in still another type for crate or baggage carrying, the gates have extensions to permit the boxes to slide to the track level.

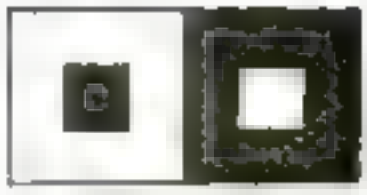
As a special service to readers, the Editor will be glad to supply the names and addresses of manufacturers of devices mentioned in Popular Science Monthly.

19364

Can You Get These Eye-Testers Right in Less than a Minute?

1. Copy this diagram quickly in freehand then make a figure 1 in the space that is in the circle, but not in the triangle or square. Also make a figure 2 in the space that is in the triangle and circle, but not in the square

Find each one of these designs in the set below, and write down its location, as specified in caption No. 4. This test and the one at the left are reproduced through the courtesy of Prof. Edward L. Thorndike

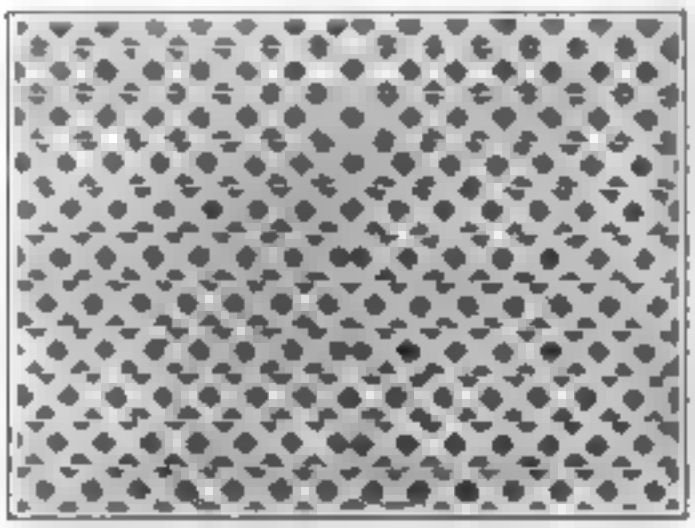


2. Which of the two inner squares in the above drawing is larger the white or the black?

Explanation Although of the same size, the white square appears larger than the black one, due to irradiation, that makes the borders of clear surfaces indistinct so that they seem to extend beyond their limits on to any darker surface that may surround them

HOW quick are your eyes? How alert are your brain cells? Do illusions fool you?

Find out by trying these famous intelligence tests. They will make instructive recreation for a winter evening's gathering Pass around slips of paper with spaces numbered 1, 2, 3, and 4. Let each person jot down in these spaces the answers to the questions contained in the numbered captions. Keep a stop watch on each contestant. Correctness of answer, as well as speed, counts in picking the winner.



3. Of the transverse lines that are shown running from margin to margin in the above drawing, how many curve upward?

4. Glance at each of the five figures lettered a, b, c, d, and e at the top of the page. Then find its counterpart in these columns. When found, indicate its location by setting down the letter it bears at the top of the page and the number it bears in these columns, in this style—f-16

The Engineer Gets His Orders

THIS ingenious mechanical contrivance is used to deliver orders between the locomotive engineers and the switchmen as the trains of the Midland & Great Northern Railway in England enter a section of single track running between Spalding and Lynn. Orders are issued at every siding telling the engineer to proceed or to draw out and allow another train already on the section to pass. Formerly this was done by hand, which forced the trains to slow down and occasionally resulted in messages being missed.

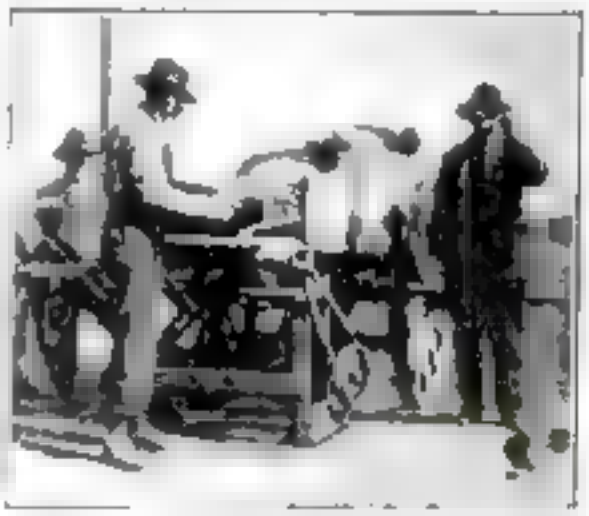
The mechanical despatcher is constructed along the lines of the automatic device by which American trains pick up bags of mail at way stations without reducing speed. The messages are placed in the small bag, and an iron arm projecting from the engine cab trips the catch and picks up the bag by hooking into the iron ring. The picture shows a switchman recovering a message dropped by a passing locomotive.

Making Heat Instantly with Chemicals

A METAL hot-water bag that contains no hot water but that is heated by admitting air to a chemical compound contained inside the case is now on the market. Its action is extremely simple. When the stopper is unscrewed for a fraction of a second, the bottle becomes warm, and will remain so for from eight to twelve hours.

Many chemical compounds liberate much heat Every one has seen the water boil when plasterers mix it with quicklime, but no water at all is used in this device. The chemicals are harmless, may be handled safely, and the bottle will not explode. The instant heat produced without the trouble involved in lighting a fire will be appreciated on camping-trips and in household emergencies.

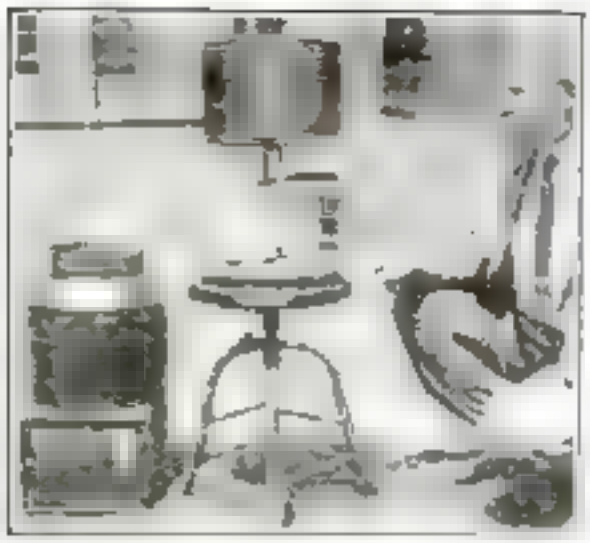
Seed Potatoes Cut by Machine



IT is no small job cutting up seed potatoes for planting on a big truck-farm, but a great deal of labor is eliminated by a machine recently devised by John O. Jacobson, of Nielsville, Minnesota.

A plunger pushes one potato at a time against a cross-shaped stationary cutter. A movable cutter cuts the same potato across the cuts of the stationary slicer

When an extra large potato rolls into the slicer, it gets on a knife-spreader that causes the blades to make two cuts instead of one. The device is operated by a motor.



Measuring and Recording Rain- and Snow-Fall

HOW many inches of snow fell by ten o'clock last night, is a question that need no longer be answered by a guess. A recording rain-gage, designed by S. P. Ferguson meteorologist of the United States Weather Bureau, weighs the total fall of rain, snow, hail, and other solid forms of precipitation at any instant during the progress of the storm, no matter what its nature

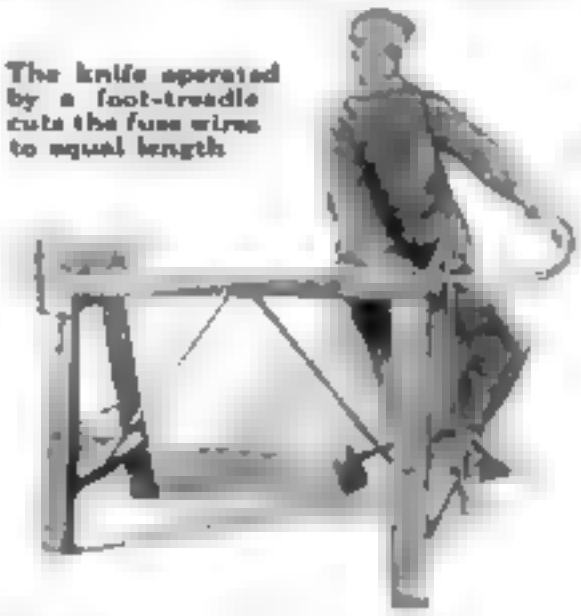
The operating mechanism is essentially a spring balance Rain or snow falling into the self-contained compartment at the top of the device depresses the spring, and the pen attached to the record lever makes an upward trace on a cylinder around which is wound a sheet of paper ruled horizontally inches and tenths of inches and vertically in hours and fractions thereof

This scale of measurement permits the precipitation during any hour of the day to be determined without any necessity for an observer to read the scale. The cylinder just referred to is rotated once in twenty-four hours by a clock with which it is connected by means of a carefully adjusted shaft and gearing.

Blasting-Fuses Cut to Safe Measure by Machine

MANY mine accidents are caused by carelessly cut fuses. It is the common practice to cut them by hand one length at a time, and as a result a fuse, intended to allow the miners a certain length of time to seek cover, would explode earlier. These premature explosions never fail to take their toll in lives.

A practical miner, has now designed and built the fuse-cutting machine shown in the illustration, which consists of a removable spool measured to one length of a bench about five feet in length and one foot in width The spool has a capacity of five hundred feet of fuse. At the other end of the bench is mounted a knife, one end stationary, the other operated up and down by a foot lever, which is counterweighted to return it to cutting position. Measuring marks are placed two and three feet from the knife.



The knife operated by a foot-treadle cuts the fuse wires to equal length

The machine is used at all the mines of the New Jersey Zinc Company In one mine using six thousand feet of fuse a day this machine saves the work of four men

Sword-Swallowing Made Possible

BEHIND all sleight-of-hand tricks there is usually a scientific manipulation that makes the trick possible. The sword-swallower of China, represented in the illustration as about to devour the sword, is no exception The sword he is swallowing is keen and highly tempered, but a mechanical device in the handle allows the blade to slide back as the cult passes into the conjurer's mouth. The point is held against the teeth as the lips draw the handle inward

The snake-charmers of India likewise have their tricks of science, unnoticed to the spellbound audience, but absolutely necessary as part of their stunt.

Combined Handle-Bar and Package-Carrier

SEVENTY-EIGHT pounds of stone is a heavy and awkward load to carry on a bicycle and the problem is solved through the logical design of the handle-bar and carrier basket illustrated This enables the load to be perfectly balanced over the axle of the front wheel. Handle-grips are fitted in the side of the twenty-two-inch basket.

The load can be handled easier when the carrier becomes the handle-bar

Ample knee room is provided, and the whole carrier is made so that it can be installed in any standard seven-eighth-inch handle-bar socket

The advantages claimed are that the load cannot joggle nor sag. The basket is of heavy gage woven wire of one-and-one-half-inch mesh over a three-eighth-inch frame, and cannot be pulled out of shape by any load which a boy can lift on to a bicycle. The handle-grips are of coiled wire, and are boxed to give plenty of room for the fingers.

Huge Battery of Flood Lights Illuminates Skyscraper

THE illustration shows the Wrigley Building in Chicago, as it is displayed by the light of 214 projectors producing nearly [illegible] million candle-power The lights [illegible] are [illegible] on the roofs of [illegible] invisible from [illegible] The cost of installation of this flood lighting was about $30,000, and the total expenditure for maintenance is about eighty dollars a night

The Saidy Date Must Go to Quarantine

EARLY in 1920, Professor S. C. Mason, of the Bureau of Plant Industry, went to Egypt to get offshoots of the Saidy date, for the purpose of experimenting with its growth in the United States.

The Professor brought back about eighteen hundred offshoots—from the Libyan Desert, the neighborhood of Cairo, and the Nile valley

Although many of the date shoots have struck root and are ready to be set out in orchards, the Bureau will not distribute them to growers because the trees have developed infection with two dangerous scale insects—the *Parlatoria* and the *Phoenicococus*. In consequence, the trees must be kept in quarantine for many years to insure the utter destruction of the pests.

Electricity Heats Water as It Passes through Faucet

BY means of an electric resistance coil nearly a foot long placed in the center of the water-pipe, this faucet will supply hot water at the rate of thirty gallons an hour. Its action is instantaneous, and there are no switches to turn, since moving the faucet handle to the left starts the electric current.

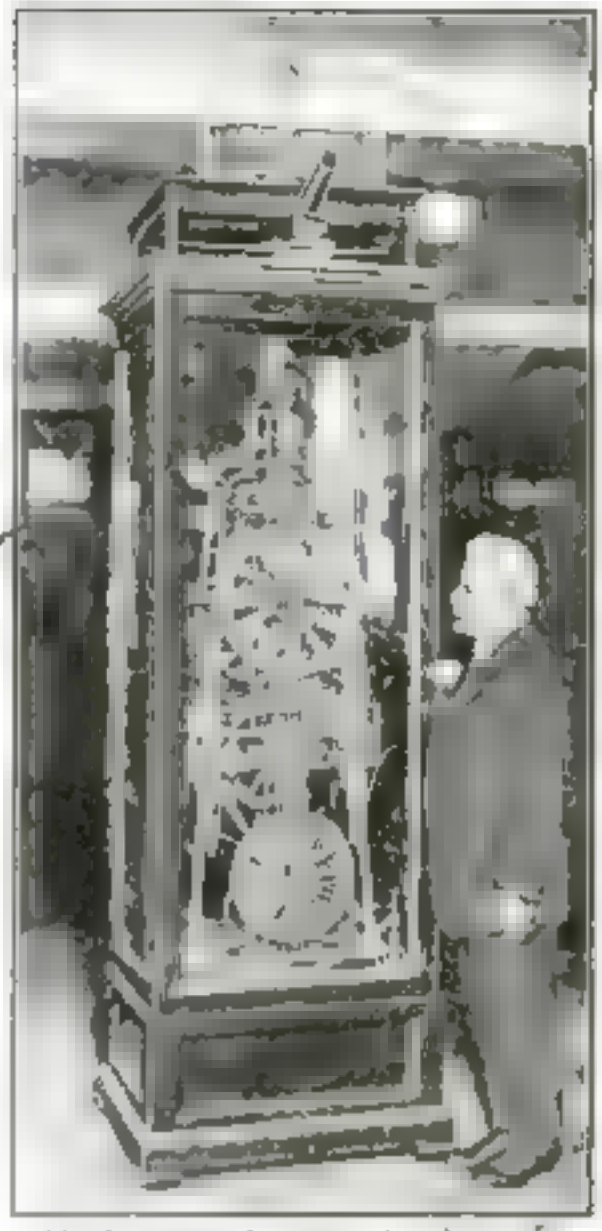
A separate circuit of No. [illegible] wire must be used, as, like [illegible] electric water heaters, the amperage consumed would burn out the switches of a lamp socket, but the invention should be a boon to mercantile establishments handling unwrapped food. Although these use little hot water, the law requires that it shall be available at all times, and this electric precludes all danger of explosions and does not waste money by heating water which will never be used.

Bamboo Clock Tells the Day, Week, Month, and Year

EVEN the springs and the wheels of this eight-day pendulum clock were carved from bamboo with a penknife. With the exception of a ten-pound leaden weight which operates it and two small glasses which serve as gongs, the entire mechanism is constructed of cane such as is found in the ordinary bamboo fishing-pole. Its inventor and maker, Constanco Renzi, a sixty-year-old clockmaker of Rome, spent the last two years whittling out the complicated works to show what Italian workmanship could accomplish with the crudest materials. He declares he could make a second clock in two months.

The clock tells the hour, minute, and second, the day of the week, the month and the year. It shows the phases of the moon and strikes the hours and quarter hours with an alarm actuated by a bamboo spring which get its wind up [illegible] morning. At noon, if desired, the works can be set so that a small flag is run up the masthead, the raising being preceded by a whistle from a bamboo tube, and one minute after the noon hour the cannon at the top of the clock is discharged.

An exceedingly clever method is used to prevent the escapement from wearing out. The escapement jaws engage spokes on a large wheel, and these spokes revolve loosely on bamboo pins, constantly presenting a new surface to the wear. As bamboo is covered by an extremely hard siliceous coating, the clock will run for years, and comparison with ordinary clocks shows that it keeps excellent time. Mr. Renzi has already refused an offer of eight thousand dollars for his clock, which he hopes to sell to a museum.

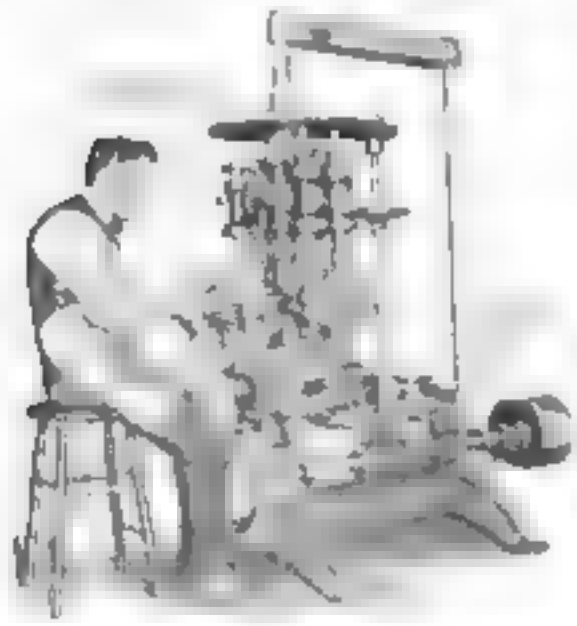


Mr. Renzi used nothing but bamboo in making his eight-day clock

Machine Makes Five Operations on One Piece of Work

THIS is another time-saving machine that will do as many as five operations on one piece of work.

Five revolving tables are provided with vises. Each of the five vises holds a tool for a certain operation; such as reaming, drilling, countersinking, or tapping. The



After performing five different operations, this machine automatically ejects the piece of work

small vises on the revolving table hold the work [illegible] tools progress.

When an operation is completed on one piece of the table [illegible] and the work is advanced to the next tool, and so on, until the complete circuit is made.

Pockets for Woman—in Her Hat!

OLD-FASHIONED lawyers used to carry their writs and pleadings in the crown of a battered hat, also a plug of tobacco, perhaps, and a bandana handkerchief.

Note how the woman of 1921 revives this ancient method of stowing pocket things. Two [illegible] of Nancy Hoyt, well-known New York milliner, were found on the exclusive Shinnecock golf-course at Southampton, Long Island, with amethyst-colored sports hats that had folds specially designed to carry a cigarette-case, vanity mirror, and powder-puff—and the photograph shows them about to be demonstrated.

In one hat the necessaries are merely slipped in and out of the folds, while in the other there is a flap with a snap-fastener.

As a special service to readers, the Editor will be glad to supply the names and addresses of manufacturers of devices mentioned in Popular Science Monthly

Combination Chair and Umbrella Makes Artists More Comfortable

COMPRISING everything an artist requires for an afternoon's sketching, with the exception of the proper light and inspiration, the entire outfit weighs only six pounds. Folded, this camp-chair can

A combination chair, sunshade, and portfolio of sketching tools for the rambling artist

be carried easily in the hand or swung on to the back. Open, and the artist has a pointed umbrella to keep off the sun, a mirror by which he may watch the country behind him and guard against the irate farmer who has sworn vengeance on the trespasser, a graduated rule for laying off his drawings, an eraser, which also serves as a plumb-bob, a bottle holding water for water-colors, and a waterproof bag to contain all these accessories while on the march.

Simple, Homemade Sterilizer for the Dairyman

A ROASTING-PAN, a galvanized iron cover with a spout soldered in the center, a metal box, and an oilstove—all articles which can be bought at any hardware store or easily constructed at home—comprise a complete outfit for sterilizing dairy utensils by steam.

This simple method of sterilization has been worked out by the United States Department of Agriculture, which describes the manner of operation as follows.

The cans should be thoroughly cleaned and rinsed with washing powder, hot water, and a scrubbing-brush before they are ready for sterilizing. When they no longer feel oily or greasy, arrange the apparatus as the illustration indicates, and test the heat of the steam escaping through the spout with a thermometer. When this registers at least 205° F., put the can over the spout, and leave it there for five minutes. Use gloves to remove the can, as it will be too hot to touch, let it drain five seconds, and then set it on the floor, mouth up. Within two or three minutes it will be perfectly dry, owing to the intense heat to which it has been subjected, and all bacteria will have been killed. The smaller implements are sterilized the same way, using the galvanized box.

A milkcan placed over this spout of live steam is made absolutely sterile in five minutes

A galvanized box supplies the sterilizing chamber for cream-separator parts

This outfit can be provided at a cost of from ten to fifteen dollars, including the kerosene stove. The equipment of the usual small dairy can be thoroughly sterilized in forty minutes, and in addition to a more sanitary product, the use of sterilized utensils will keep milk fresh for a longer time.

Dishes or implements that are clean are not necessarily free from bacteria. Even milk that has been produced under the closest scrutiny and with perfect cleanliness contains a few bacteria. Every time that milk or milk-containers are handled, a certain number of bacteria are added and it is only by sterilization at 212 degrees that these bacteria and germs can be killed.

Realizing that the usual equipment was too bulky and complicated, the Department of Agriculture perfected this simple sterilizer.

Miles away the words written by this man will be reproduced automatically on sensitized paper

Write a Personal Message by Telephone

WRITING with a lead-pencil at one station and reproducing the handwriting at another place is in itself nothing new but when the reproduction is accomplished by a minute beam of light acting on photographic paper, it is worth mentioning. The illustration shows the sending station of an apparatus of this nature.

The sender simply writes down whatever he wishes to send on the roll of paper passing through his machine. Ten seconds later the message has been imprinted on a strip of sensitive paper and developed automatically in the receiving device. The apparatus may be used over any telephone or telegraph line already existing.

MOST "French" briar pipes actually come from Corsica. The Sicilian briar-root is considered the best.

Spectroscope Detects Minute Bloodstains

BY the newest spectroscopic methods of analysis, one five hundred thousandth part of a drop of blood on a criminal's clothing is enough to convict him of murder.

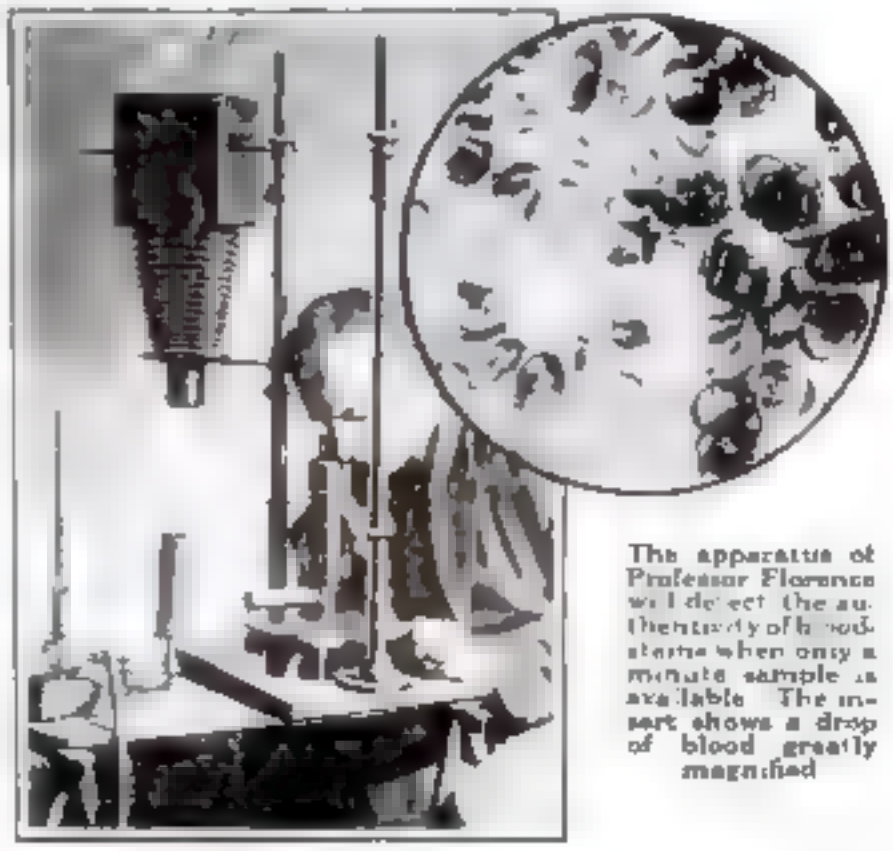
With the new system perfected by Professor Florence, of Lyons, France, the smaller the amount of blood, the more certain and easy is its recognition. This is of immense advantage to criminologists, since when sharp weapons are withdrawn from a wound they are usually wiped clean of blood, but an infinitesimal amount of blood by the victim's clothing, and the detection of the presence of human blood on the assassin's knife is often impossible by chemical methods.

Professor Florence makes photographs of the spectrum of blood, or of the blood corpuscles themselves while they remain on the object examined, so that if need be, the jury need not credit the testimony of the expert, but can repeat the tests for themselves. His apparatus consists of a microspectroscope in which a powerful beam of light is directed through the horizontal tube at the left on to the knife-blade beneath.

When the scientist discovers a bloodstain, it is readily photographed by swinging the camera at the left into position over the microscope. Examination of the size and shape of the blood corpuscles determines whether or not the stain is that of a human or of an animal.

The camera is so constructed that the degree of enlargement of the blood corpuscles may be varied at will without changing the focus of the microscope. Sometimes, however, the form of the corpuscles has been destroyed, and in these cases a spectroscope is used to afford positive identification.

With this method bloodstains scarcely to be seen on colored fabrics can be recognized. In one test, a single bloody thread only 0.04 of an inch long, was placed under the microscope and treated with Virchow's fluid mixed with a little honey to remove the dye and brighten the color of the bloodstain. Instantly the spectrum of hæmatin, characteristic of blood, appeared under the microscope—a complete proof of a crime, although only one five hundred thousandth part of a drop of blood was present.



The apparatus of Professor Florence will detect the authenticity of bloodstains when only a minute sample is available. The insert shows a drop of blood greatly magnified

Odd Items of Interest from Around the World

Indian Folk-Songs Are Preserved by the Government

SONGS for burial, for marriage, and for birth, in fact, for every important occasion that arises in his life, are the kind of songs sung by the American Indian.

Some of these songs date their beginnings when the Indian was master of the American continent.

Even now the red man will be of the past, and so the United States Government is now having phonograph records made of the old Indian songs. That is what the splendid-looking Indian in the picture is doing—canning his tribal songs.

Man-Propelled Trolley in East Africa

MOMBASA, in British East Africa, can show the foreign visitor a unique system of man-propelled trolleys that are deficient in speed but will compensate in such a country for travel and an unobstructed view. A covering such as seen on a baby's perambulator, shades the rider

No Contest to Occupy This White House

EVERY year the biggest turkey is shipped to the White House for the President's Christmas dinner by the town or county that has raised the heaviest and finest bird, and this is the crate, in the form of a White House in which the bird is shipped.

There is no higher honor to which a turkey can aspire than to become the final of this crate. It marks him as the finest specimen in the land; but in spite of the distinction conferred, no turkey has as yet appeared eager for the nomination.

Dark Stranger Appears in Space

AN astounding discovery by a Dutch scientist of a heavenly body twenty million times larger than the sun has introduced a new factor into astronomical circles.

It is thought that the body is a huge cloud of dust that will eventually become a star. Measurements made of the dark mass show it to be 140,000,000,000,000 miles long and twice that far away from the earth.

Moving Roadway for Japan

JIROZAKA Hill in Yokohama, Japan, separates the exclusive foreign colony from the shopping district and presents a serious obstacle to motor-cars and rickshaw men.

The city authorities have been asked for permission to construct a moving roadway leading over the hill. A Japanese engineer thought of the idea, and purposes to operate the road by electricity, charging toll of all vehicles that use it.

Delivering Beer with a Hose

UNFORTUNATELY, this chap is not delivering gasoline through the hose, but beer; still more unfortunately, he is delivering it in the British Isles. A scarcity of wooden kegs compelled the brewers to distribute Budweiser in tankers and motor-lorries.

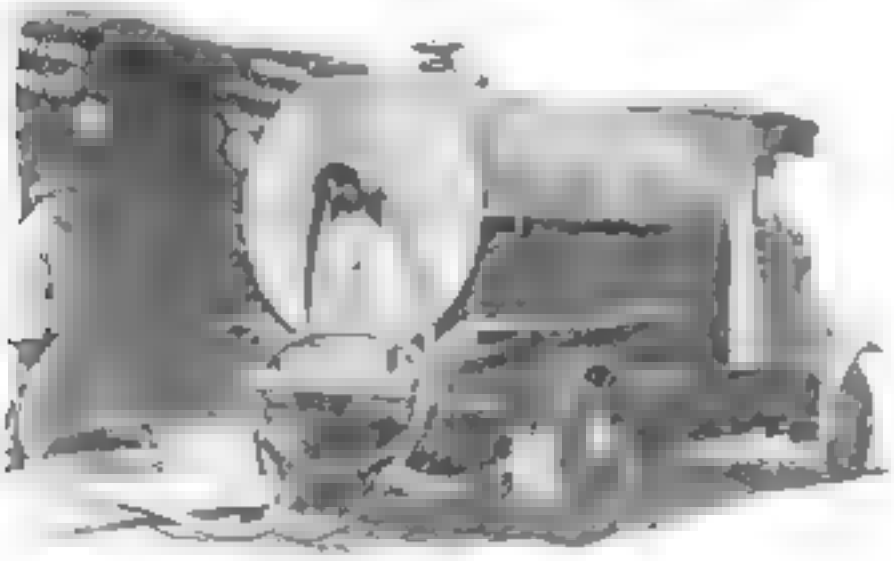
There was considerable complaint from those who feared the flavor of the beer would be spoiled by contact with galvanized iron and rubber; but these fears proved unfounded.

The second hose on the rear of the wagon is used to deliver light beer. The tank is divided into two sections, and the other hose will be used as soon as this "public house" has been supplied with all the dark beer its patrons are likely to require.

Shallow Draft Towboat for the Mississippi

THE *Natchez* is the most powerful river towboat ever constructed in this country or abroad. She will tow six steel barges, each 230 feet long by 45 feet beam with a maximum carrying capacity of 2000 tons. She is built of steel and equipped with oil-fuel boilers and two triple expansion engines.

As the river is shallow at the place, the twin screws are set in tunnels built in the bottom of the ship so that they cannot foul if the ship grounds on a sandbank. The flow of water to the propellers is unhindered, and four rudders, one placed both forward and aft of each propeller, make the maneuvering qualities of the *Natchez* excellent, and she can run full steam ahead in water as low as seven feet.



Special compartmented metal tanks mounted on trucks are used to deliver beer in Great Britain

The largest river towboat in the world has twin propellers revolving in tunnels to prevent fouling in shallow waters

19305

From Ore to Capsule—

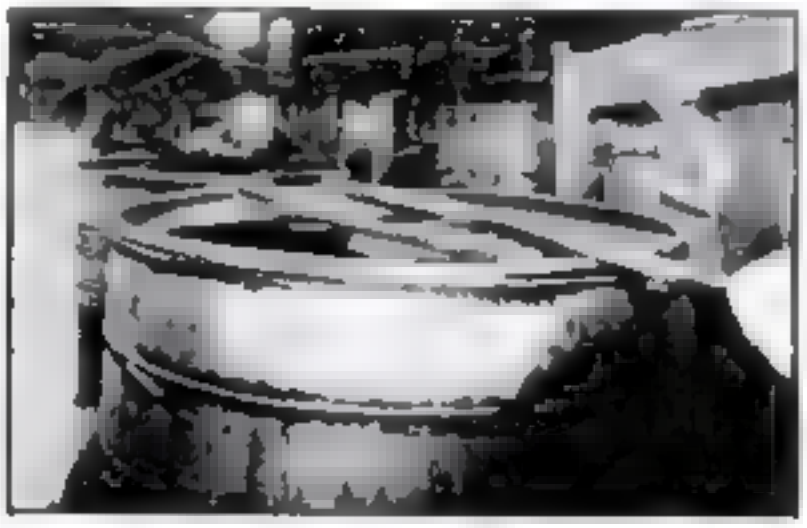
Striking picture of the little known process of

Photographs © U. S. Radium Corporation

Carnotite ore, from which radium is obtained, is mined principally in Paradox Valley, New Mexico. The ore is placed in sacks and carried in teams over the rough country to the railroad. It requires about six hundred tons of carnotite ore to produce one gram of radium

At the refinery the first operation is the cleaning of the ore in huge black vats. It is a complicated process but the first step before the refinement is complete and the radium ready for use

During the refining process other valuable products such as uranium and vanadium, are extracted from the ore by chemical treatment. Vanadium is an important element in steel manufacture



The solution containing barium and radium salts in the ratio of ten parts of radium to a billion is treated with sulphates to precipitate an insoluble "raw sulphate of barium"

Film-Projector and Screen in the Same Cabinet

PICTURED here is a motion-picture projector that includes within one cabinet the necessary film-storage space and the screen for showing the picture. A unique arrangement of prisms makes it possible for the picture to be projected outside the cabinet and on to a larger screen set at a distance for home use.

The film is projected on to a screen set into the cover of the cabinet

Perhaps the most interesting feature about this cabinet is the method by which the film is stored so that by connecting the two ends correctly the film may be run continuously as long as desired. A special safety device stops the motor driving the machine when the film breaks.

The projector consists of the usual incandescent lamp, intermittent movement revolving shutter and projecting lens. A steel fireproof cabinet is furnished for the safe storage of the film

Rolling Desk for the Use of Crippled Children

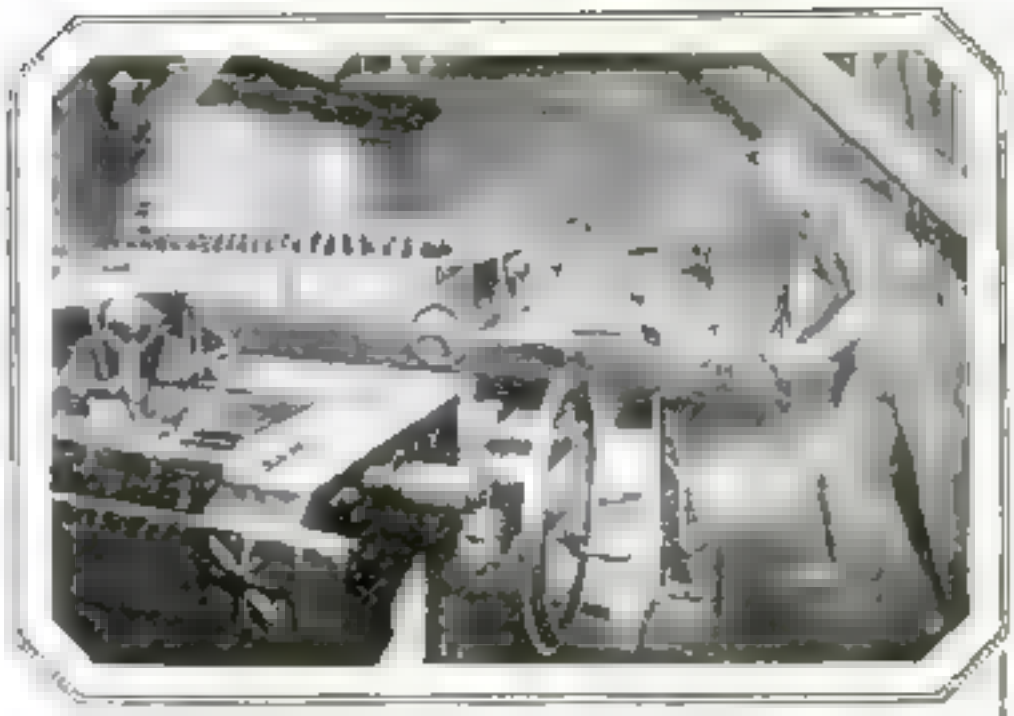
THERE are so many crippled children in our classrooms in New York city alone seventeen hundred and one taken to school daily by automobile—that a special movable desk shown in the picture at the right, has been designed to permit children unable to walk to participate to some extent in the regular school activities of their classmates.

The desk, or chair, has a special support for the legs, and can be adjusted in every direction so that the child can rest in the most comfortable position

With this rolling desk crippled children can attend schools without discomfort

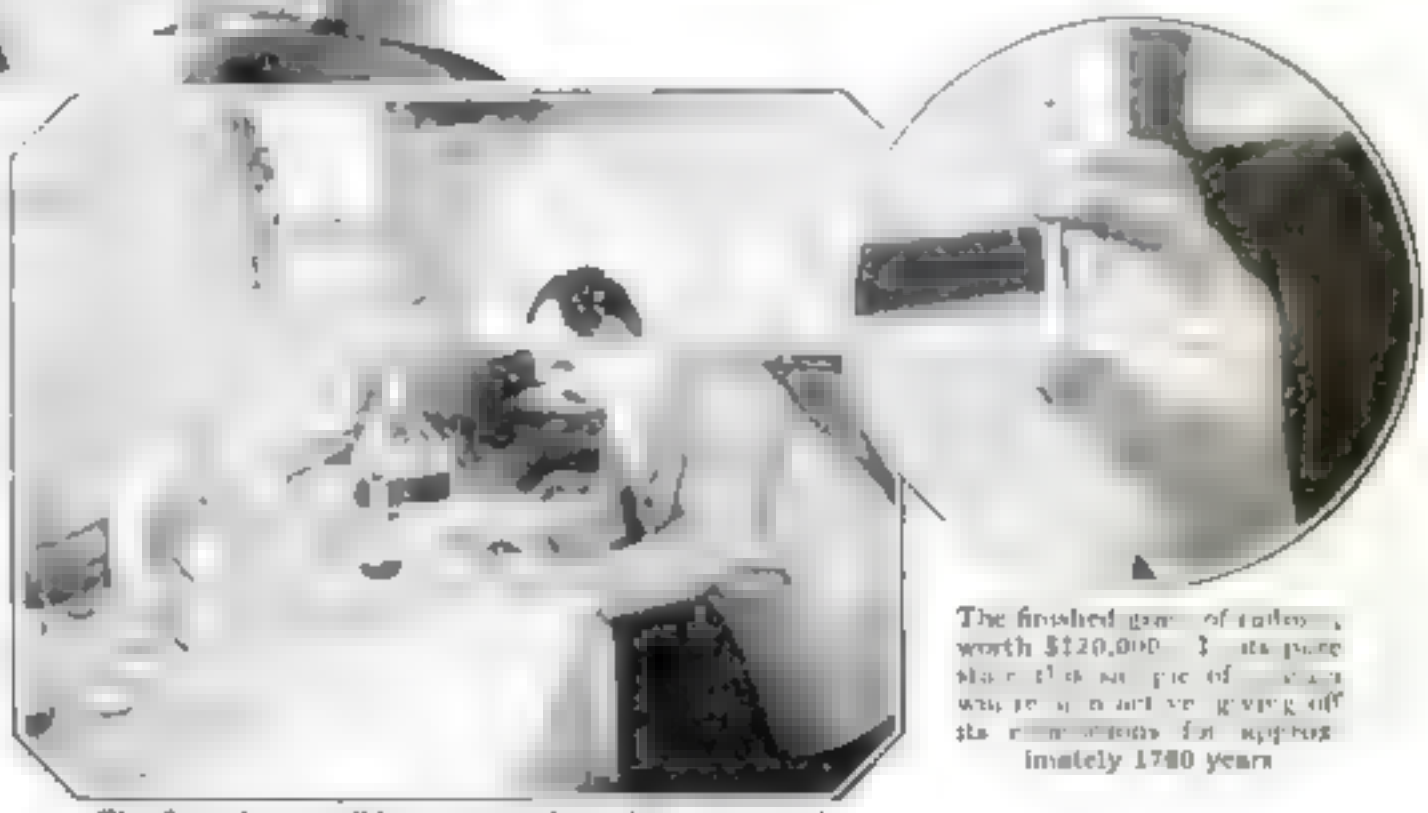
The History of Radium

refining six hundred tons of ore to a gram of radium



The fluid from the chemical vats is run into filter presses and compressed between sheets of chamois-skin. As the liquid runs out it is tested for its percentage of radium

From the filter presses the liquid containing radium is placed in crucibles over burners and carefully evaporated. In the room shown above the chemists have more than $500,000 worth of radium



The four tiny crucibles contain the radium extracted from the original six hundred tons of ore. It has required the labor of five hundred men for six months

The finished gem of radium, worth $120,000, [illegible] its place [illegible] giving off its [illegible] for approximately 1780 years

Purdue Has World's Largest Base Drum

IT is seven feet high and four feet from drumhead to drumhead. It is wheeled along on a little carriage during parade. When mounted on its stand the top is nine feet from the ground. The tone is deep and rather subdued, but it has a wonderful volume and resonant power that make this drum able to balance the most strenuous efforts of a 125-piece brass band.

The world's largest drum was not constructed without difficulty. It took several months to find two bull hides large enough for the heads, which are one hundred inches in diameter. Such heads put a great strain on the shell, which required special reenforcing and a novel type of screw-rod manipulators for varying the tension of the heads. After the instrument was completed, it was found that the doors of the ordinary baggage-car are not large enough to admit it, and a special car will be necessary when the band goes on tour.

Pontoons to Replace Ferries

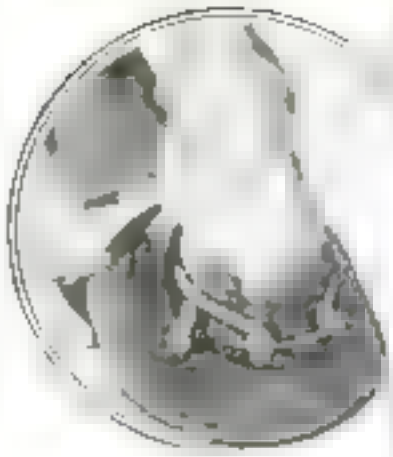
PONTOON bridges across Lake Washington have been proposed to relieve congestion on the ferries of Seattle. Fifteen wooden vessels constructed for the United States Shipping Board would be used as floats, and upon them an eighteen-foot roadway and two four-foot sidewalks would be constructed. Drawbridges would be provided to permit navigation.

As a special service to readers, the Editor will be glad to supply the names and the addresses of manufacturers of devices mentioned in Popular Science Monthly

Renews Blotting Surface after Each Operation

A BLOTTING-STAMP has been invented in Germany that constantly renews itself. Thin blotting-paper on a spool covers the bottom of the stamp and rewinds around an idler. Each time the stamp is pressed down, it pushes a little pawl that trips a ratchet gear, winding up the idler.

A ratchet mechanism renews the blotting surface each time the blotter is used



Shoes for Equine Bog-Trotters

A ROUNDED wooden plank about one [illegible] thick, fitted with straps and springs that fasten [illegible] to a horse's hoof [illegible] The horse puts his foot [illegible] the center of the plank and when the clamps are fastened as indicated in the illustration he [illegible] walk where [illegible] without sinking into the soft soil.

Does a coral island grow from the top down or from the bottom up? An American professor is leading an expedition to the South Seas to settle the question. Darwin stated that the coral grew naturally from the bottom but recent scientists contend differently, hence the expedition. Coral is a substance secreted by the marine polyps.

Curtain of Water Safeguards Books

EXTERNAL sprinkler systems have been installed along the eaves of the Chicago Public Library to protect the priceless volumes in the building from the danger of fire. In case a blaze starts in any of the structures near by a wall of water falls from the roof of the library, extinguishing flying sparks and protecting the building against heat and smoke.

Disk Improves Phonograph Tone

CLEARER tone, a purer musical quality, as the total eliminat[illegible] all scratching and scrap[illegible] [illegible] phonograph attach[illegible] [illegible] and ball into which the [illegible] fits with only [illegible] an inch of the tip protruding. The ball rests on the surface of the record. The disk is arranged parallel with the record.

In this way the incidental vibrations imparted to the needle by dust in the groove or a worn path are separated before they reach the reproducer while the vibrations are passed or dampened. The music produced is not loud, but sweet and clear.

Fewer people are dying this year according to the Metropolitan Life Insurance Company, the death rate being 23 per cent below that for 1920.

Hand Fire-Extinguisher Uses No Liquid

POWDERED carbonate of soda and carbon dioxide gas are blown over a fire by this [illegible] in Germany. The chemicals are dry and no water or sulphuric acid is used. The result is a great reduction in weight without loss of efficiency.

The gas is compressed in a strong container. When the valve is opened, the gas is blown through the powdered soda, and the mixture blankets a fire without the danger of short circuiting electric wiring, which is the drawback of the liquid soda apparatus. In the test illustrated, a wooden structure, smeared with benzine and tar and burning furiously, was extinguished in ten seconds.

Building-Blocks Made on Continuous Molder

INVENTED by George C. Debay of Springdale, Pennsylvania, this machine forms blocks accurately and rapidly at greatly reduced cost. The molding parts [illegible] on an endless conveyor. Each member f[illegible] side of the mold.

The upper portion [illegible] is made in movable sections. A [illegible] an opening formed in the sides [illegible] sections may be swung into position over [illegible] core-bar to enclose same.

Plastic material is fed to the molds through a spiral conveyor.

Dry chemicals instead of liquids compose this fire-extinguisher. The gas carries the powder to all parts of the blaze and smothers it

By placing the parts of the mold on a traveling conveyor, the manufacture of building-blocks is carried on continuously

19761

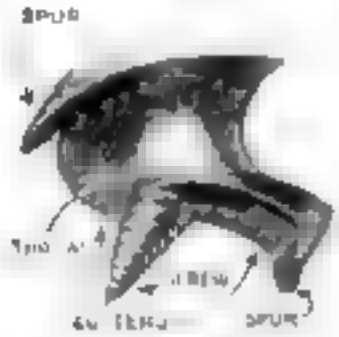
How to Get the Most from Your Bit

No. 2 in a series showing How to Use and Care for Tools

When the cutting edge becomes dulled, it can be restored by drawing a file across both cutters. Do not attempt to file the outside edge of the bit head

The illustration above shows very clearly how the screw, the spur, and the cutter work together in cutting away the wood and cutting it out of the hole

Sometimes, but not often, the spur—which is the sharp point that scores the wood and outlines the hole—needs sharpening. To do this, hold the bit as illustrated above and draw the file backward, filing lightly and on the inside only



The cutter head must be kept in good condition to make the bit cut cleanly and evenly

Screw pitch varies with the size of bit and work. A quick thread is for rough work, a slow thread for fine work

Bicycle Steers from the Rear

19162

AN English inventor, Mr. Fenner, claims that his reversed bicycle is very easy to ride uphill and unusually light on tires, since the weight is borne equally by both wheels. The mechanism of the usual bicycle is exactly reversed. The drive is from the front wheel and the steering from the rear. The rear wheel is connected with the handle-bars by a rod attached to the crown at the head of the machine.

This bicycle steers from the rear wheel and is driven from the front

Why Do We Do It?

Why do we run the engine with the garage door tightly closed?

EXHAUST gases from an automobile contain a large percentage of poisonous carbon monoxide—the fatal "fire damp" so dreaded by miners. When a cold engine is warmed up inside the garage, with the doors and windows tightly closed, enough of this gas is produced to constitute a serious fire risk and danger of explosion.

Breathing it for only a few minutes may cause a prolonged headache.

Carbon monoxide combines instantly with the hemoglobin of the red corpuscles of the blood to form a stable chemical compound that persists for hours, even in the open air. During that time the corpuscles are unable to absorb oxygen from the air. The effects of breathing carbon monoxide for a few minutes are the same as those that would follow the temporary loss of a pint of blood. Open the garage door when the engine is started.

WHAT DO *YOU* DO

that you know you shouldn't?

What are some of the familiar practices of every-day life that we all know are stupid and yet that we rarely try to conquer?

Send your suggestions to the Editor

Plowing with a Street-Car

19460

RECENTLY, when the Sioux Falls traction system had found it necessary to plow up the roadway in order to install a switch, they decided to use their own power for this work. To one of their work cars they fastened an outrigger a ten by ten inch timber, upon which was an extra heavy [illegible] plow.

The heavy chain which pulled the plow could be slid back and forth on the outrigger timbers, in order to adjust the position of the furrow. The improvised work-car plow accomplished more in three hours than could have been done in a day's time with teams.

Outrigger and plow used by a Sioux Falls company to tear up the roadbed

Try These Speed Indicators on Your Mental Gears

A Course in Quick Thinking, conducted by Sam L

1910

$25 in Prizes

EDUCATORS say the puzzle motive is the best kind of mind-training exercise, because it comes as sport instead of drudgery. As proof of this consider the fact that Sam Loyd's most faithful puzzle fans have been inventors, engineers, and business men.

A first prize of $10 will be awarded the reader who sends in the best set of correct answers and analysis covering the four problems on this page, a second prize of $5 for the next best set, and ten other prizes of $1 for the ten next best sets.

Answers must be received not later than January 9, addressed to the Puzzle Editor Popular Science Monthly, 225 West 39th St New York, N Y

By "best" is meant absolute correctness of solution—then, if other points must be considered, clearness of analysis. Mr Loyd's decision must be considered as final. In case of a tie, each competitor will be awarded the full amount of the prize tied for

Answers and names of the prize-winners will be published in the April issue

Lighting the Boulevard

AFTER the trustees of a small township had voted an appropriation to provide for a fixed number of electric-light poles to skirt the main highway through their bailiwick, the Ways and Means Committee made a report to the effect that if the poles were set 440 yards apart, as had been suggested, they would need three more poles, whereas if they were erected three quarters of a mile apart, there would be three poles left over

There were the usual divergences of opinion that are so familiar to all small-town meetings, and after listening to the individual view of each trustee, the chairman decided to settle the matter himself

"Go ahead and use the poles provided for," he ordered; "have them equidistant apart and see that you use all of them."

If the chairman's orders were carried out and the extreme poles stood on the town boundary lines, what was the distance between poles?

18

How Much Was Offered?

A REAL-ESTATE dealer was endeavoring to sell an old condemned building to a house-wrecker, of course, for the best price that he could get. The wrecker didn't think much of the condemned structure, but was willing to do business on a basis of $1500 less than the owner's asking price.

After going over his figures several times more, the owner finally came down 25 per cent in his demand, but there still remained a difference of $1250 between the owner's and the wrecker's figures, and the deal was declared off

What was the wrecker's offer?

A Practical Referee Settles the Question

EIGHT wrangling heirs, who were equally interested in a certain piece of land, took a map of the property to an attorney and begged him to make an adjustment so that there should be no more wrangling.

After giving the matter due consideration, in Solomon-like manner the attorney picked up his shears, and cutting the blueprint into eight sections, gave one to each.

"There, you each have a piece of the same shape and size. Divide your property likewise."

The miter-shaped diagram in the illustration is of the property in question. Who can duplicate the attorney's feat and mark off the figure into eight sections of similar shape and size?

When Were the Cars Nearest Together?

TWO friends who had been automobiling through the same section of the country, without being aware of each other's whereabouts, subsequently found it interesting to figure out how close they had come to meeting

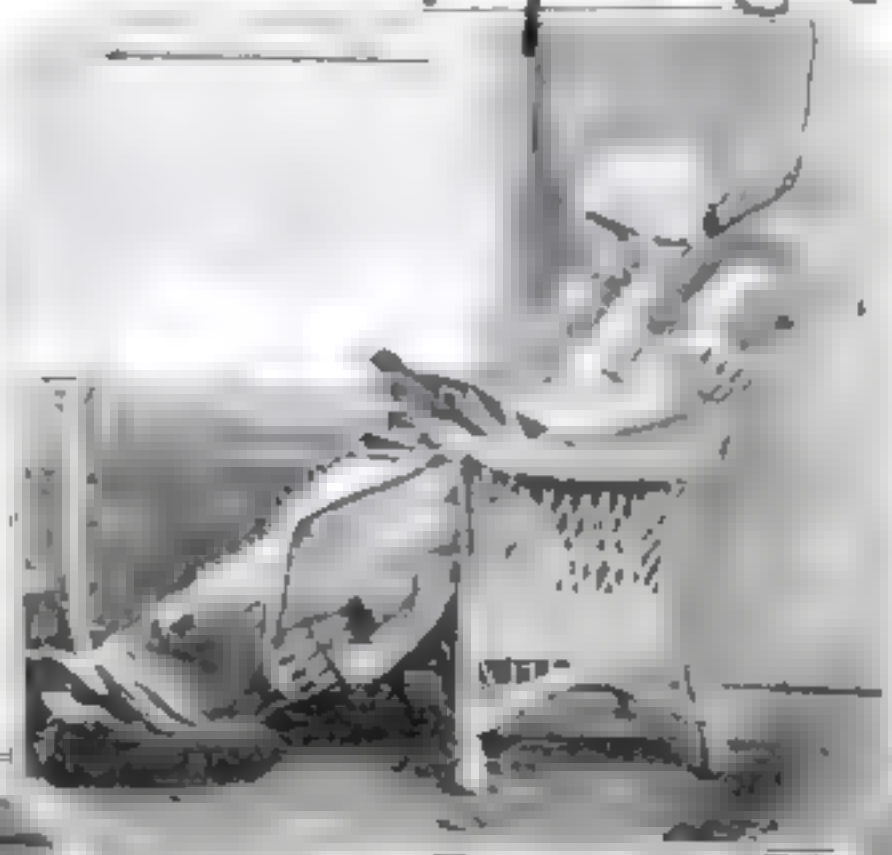
It appears that A came from the north on a highway that crossed at right angles another road, running due east and west, on which B at the same time was moving eastward. Thus their data resolved into a problem that may be presented as follows.

A and B started from north and west simultaneously, A going from north to south at the rate of 32 miles an hour; B going west to east at the rate of 24 miles an hour From A's northern starting-point to the crossroads is 60 miles; from B's western starting-point it is 70 miles.

If they started their journeys at 12 o'clock, noon, and traveled steadily for three hours at their respective speeds, at what time were the two cars closest together?

For the Comfort and Convenience of the Family

An adjustable light combined with a reading-stand will give the final touch of comfort to a wintry evening at home by your own fireside

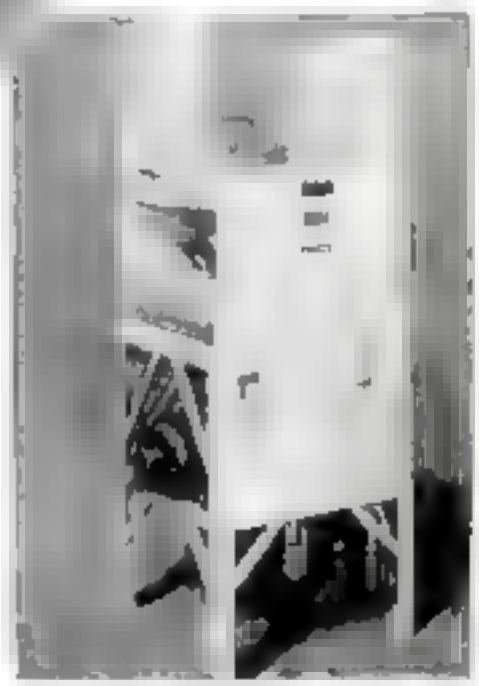


Be sure of the quality of rubber rings before food is packed in a good rubber ring should support the equivalent of a gallon and a half of water

A portable fumigating outfit for the sickroom consisting of a pan in which the disinfectant is placed above a flame and a keyhole in the door of the room to be fumigated

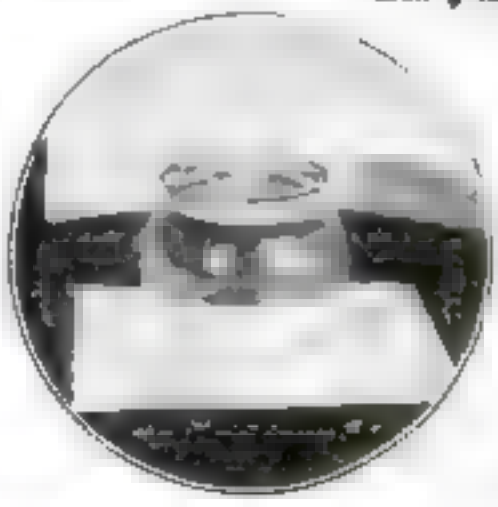
The electric coils woven into the fibers of this blanket are connected with an ordinary lamp-socket and current from the latter constantly warms

The light from gas-mantles can be increased by keeping them in vinegar It is also claimed that this makes the mantles stronger



A dasher blade in the base of this dish-washer throws a cleansing stream of water over every dish and pans are dry within less than a minute It is operated by a motor

When not used for dish-washing this mixing link can be turned back so that the water will run over the dishes without splashing everything in sight



A deodorizer and night light can be made by placing a small piece of camphor in a dish of water and lighting the camphor

This attachment is for sewing heavy materials The needle is forced into the fabric a spring arrangement pulls it through

By cutting the cake as shown, it may be consumed down to the last crumb without becoming dried due to exposure

Teeth of different lengths similar to those found in the woodman's crosscut saw make it possible to cut new cake into very thin slices

He Gave the World an Improved Battery

Newly invented process reduces weeks to seconds in forming battery plates

Pedro G. Salom, inventor of a method to reduce the process of lead-plate formation from weeks to seconds

A FUNDAMENTAL improvement in battery manufacture that reduces the time required to form a lead plate from weeks to seconds has been made by Pedro G. Salom, of Philadelphia, for thirty-five years a prominent figure in the manufacture of storage batteries.

The new battery is not only cheaper in cost, but it will increase the voltage 5 per cent over that possible with "pasted" battery plates, and will enlarge the capacity more than 25 per cent. It is said to be the first basic improvement to be made for more than forty years—since 1881

Salom forms negative plates by applying the spongy lead directly to the grid by hydraulic pressure. It is one operation, finished in a few seconds. Other processes laboriously build up a spongy lead plate by pasting litharge on the grid by hand, later converting this oxide to spongy lead by slow, laborious electrolytic processes that take weeks. The oxides must be pasted, dried, formed, cured, and developed. Under the Salom method, the material is simply applied at a pressure of fifteen hundred pounds to the square inch, and the battery is ready for use. Manufacture becomes a direct process instead of an indirect one. The improvement in operation is due to the fact that the enormous pressure exerted in squeezing the active material into the grid establishes a mass conductivity not possible to obtain by hand work

The improved storage battery is the outcome of an earlier discovery of Mr Salom's, by which he improved the process of reducing lead from the ore by electrolytic methods. Under this method the lead is recovered in the spongy form, precisely as it is found on a fully charged negative storage-battery plate, and, familiar as Mr Salom was with storage batteries, it seemed to him wasteful to convert this spongy lead into litharge, send it to the battery manufacturer, only to have him paste it on the grid and reconvert it into spongy lead again. His training as an electro-chemical engineer made him able to produce the active constituents of storage batteries, namely spongy lead and lead peroxide, in bulk. The difficulty was to hit on a process of applying them to the grid

He found that if a mass of spongy lead is washed in water and then dried to the exact degree which arrests a superficial oxidation of the lead at just the proper stage, it might be compressed on to the grid without destroying its spongy nature. If the mass is too dry, or too moist, it is pressed into a solid sheet, useless for storage-battery work. The lead peroxide is moistened and pressed on the positive plate in a similar way, a special binder being used.

As a result the plates hold more active material, and the voltage and life of the battery are increased. To demonstrate the superiority of his invention, Mr Salom constructed a miniature plant, which he set up in the factories of the leading manufacturers of automobiles throughout the country. He made his battery plates before their eyes, put them in a standard container, and allowed the automobile engineers to run comparative tests with the best "paste plate" batteries.

A row of electrolytic cells in which the spongy lead for the Salom grids is produced

Vacuum Cleaner for Automobile

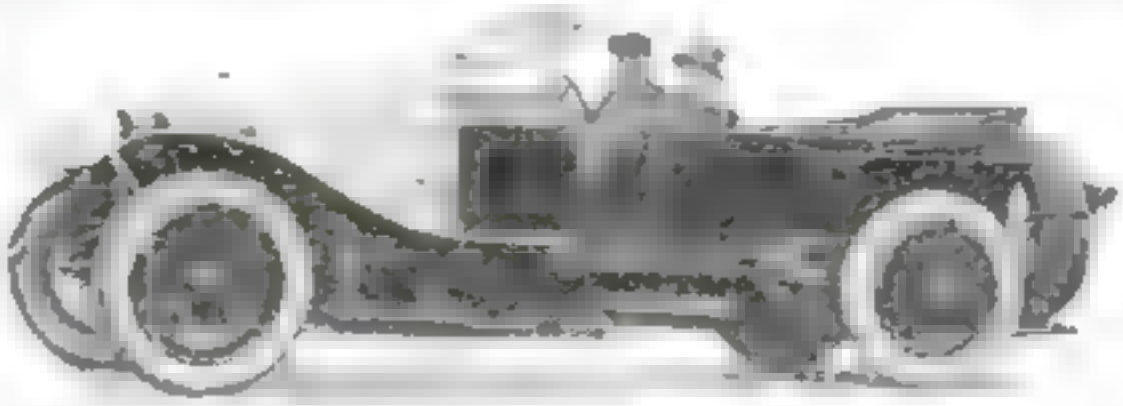
THIS compact vacuum cleaner has been made unusually light and portable with a long electric cord so that it can be carried into every nook and corner of the car. A limousine is rather hard to clean and the amount of dust that sifts through the windows in a day's travel is surprising.

In spite of its small size the vacuum cleaner will do the indoor housecleaning as well as the larger machine. It operates on either alternating or direct current

A Jeweler's Idea of Car-Building

WHEN a Fifth Avenue jeweler adopts automobile-body building as an avocation, the result is likely to show the effect of his professional love of fine finish and beauty of line. As the illustration shows, the jeweler has left the beaten paths of motor-car design.

He took a special sport chassis, built in 1915, with a wheelbase of 143 inches and an engine of seventy-five horsepower. He stripped off the old-fashioned body and built on the rugged frame a car that is ultra modern in every respect. For instance, the mudguards are double, in order to hide the supporting bolts, and are heavily outlined in brass to prevent rattles and squeaks. A brass strip, so attached that no screws or nails show, runs along the entire upper edge of the body behind the cowl. A dashboard of aluminum was installed containing speedometer, altimeter, cigar-lighter, pressure-gage, ammeter, voltmeter, motometer, clock, oil indicator, lighting buttons and switch. The cutout was ingeniously placed on the steering column, while the air-pump, choker, and other instruments were placed on the side of the car within easy reach of the driver's right hand. A special spotlight, with a long handle was another novelty



When a jeweler set his hand to automobile design, this was the result. Virtually every part is a radical departure from conventional plans

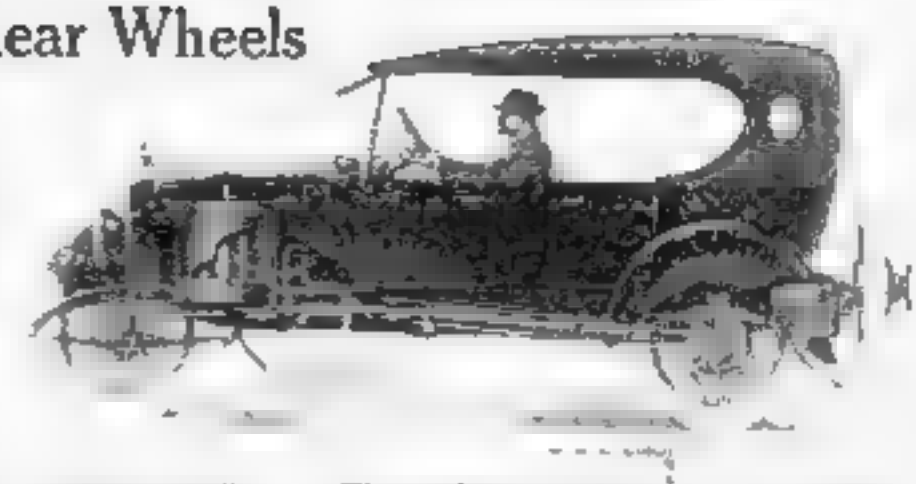
New Steam-Car Has Engines on Rear Wheels

THE thousand-dollar steam-car is now in process of production. It is an attractive, five-passenger machine of conservative design. The boiler is placed under the hood, with the engine located in the rear axle, where it takes the place of the usual differential mechanism. Three cylinders drive each rear wheel direct without intermediate gears. Each three cylinders are disposed at 120 degrees and their pistons are connected with a common crank-throw, which is merely an extension of the axle-shaft that runs to the wheel. Inasmuch as each wheel has its own engine, no differential mechanism is required. In fact, there are no gears at all in the rear axle.

Exhaust steam is delivered to the radiator which acts as a condenser. Transmission of steam to and from the rear axle is through two pipes, the top one connecting boiler and engine and the bottom one the engine and radiator. The lower pipe also acts as a torque tube, relieving the car-springs of driving and torque strains. The forward end of this pipe terminates in a ball joint.

The exhaust steam from the engine is condensed in the radiator and flows to a small water-tank from whence a pump forces it into the boiler. The boiler is a water-tube operating at six hundred pounds pressure and the fuel used is kerosene.

This new steam-car, in common with all recent designs, employs the principle of intermittent boiler operation. In years gone by steam-cars, like locomotives and stationary power plants operated on a constant boiler pressure and the feeding of steam and water was varied to keep constant pressure. In order to make this work automatically the machine was loaded with complicated devices that had much to do with the decadence of the steam principle in past years.

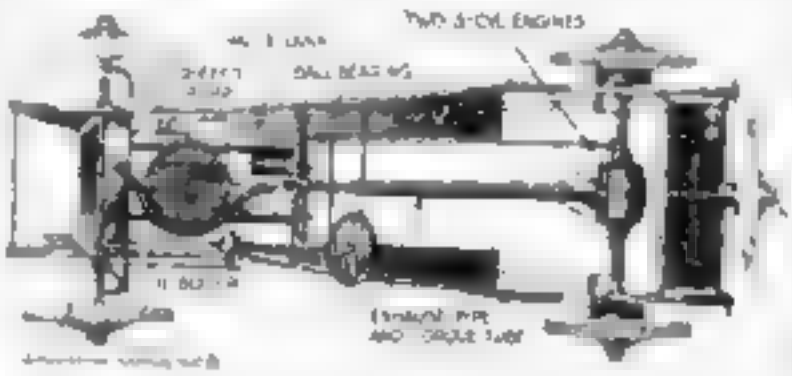


A broken-away view of the steam-car and its boiler and driving mechanism. The steam generated under the hood is carried by long pipes to the engines on the rear axles

The modern idea is to operate the boiler intermittently. For example, when the pressure reaches six hundred pounds, fuel, air and water pumps stop working, and the fire under the boiler goes out. When the pressure drops to, say, five hundred and fifty pounds, perhaps a minute later all three pumps start again, a spark-plug lights the fire and the boiler runs full blast until the pressure rises again to six hundred pounds.

It is easy to see that the operation of the system is simplicity itself. Fuel, water and air pumps are driven by a single electric motor. When the pressure drops to five hundred and fifty pounds, the circuit is closed, and when it reaches six hundred pounds it is automatically opened.

Current for the electric motor that keeps everything going is supplied from the regular lighting circuit. The generator that supplies the storage battery is located under the floor boards and is driven by a long shaft from the rear axle.



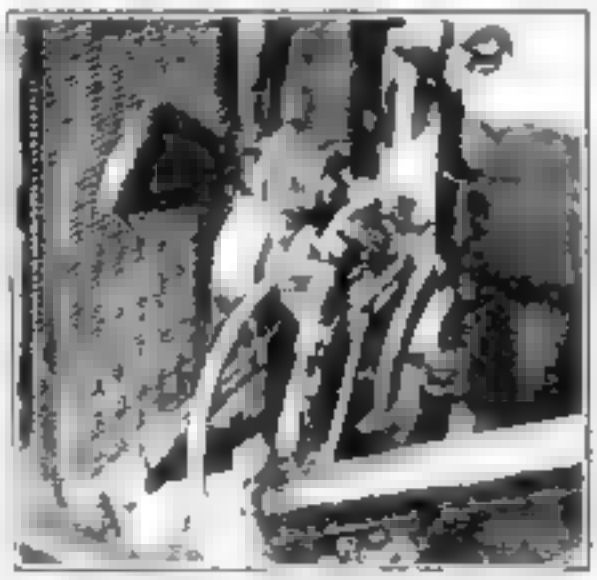
The chassis of the low-priced steam-car. Its steaming action is automatic and is regulated by an electric motor fed from the lighting system. There are no gears in the car, the position of the engines eliminating all need for differentials

Fan-Belt Drives Tire-Pump

SOMETHING new in automobile accessories is a rotary power-driven tire-pump that occupies less room in the toolbox than the ordinary hand pump.

The pump consists of a wheel that is rotated against the fan-belt and which is the cylinder of the pump. The rotation of the cylinder actuates an eccentric that operates through a hole in the cylinder and delivers the power to the piston of large diameter and short stroke. This takes in the air through a shaft containing a port, which opens and closes for the admission of air. The air is compressed and forced through a mohair-covered tube attached to the tire valve. The bracket provides means for attachment to the car through a bracket that is bolted behind the fan-belt. The spring from the bracket to the handle of the pump maintains the necessary friction to insure rotation of the cylinder by the power from the fan-belt.

The entire device weighs less than four pounds.



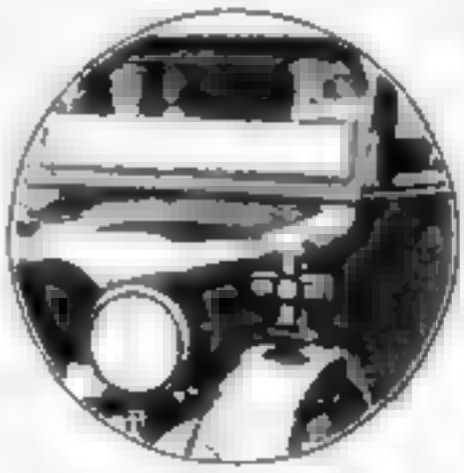
The pulley of this rotary pump driven from the fan-belt is also the pump cylinder

Keep Axle Grease off the Brakes

THE grease in the axles of Ford and Chevrolet cars will often work out through the axle housing on to the brakes. If this should happen through wear of the axle parts, the trouble may be eliminated by a new device made especially for the two makes of cars mentioned. The device consists of a single steel spiral spring that fits closely to the axle-shaft. It revolves with the live axle-shaft and works the escaping grease back toward the differential housing.

To install them it is necessary only to slip the springs over the axle-shaft and replace the bearings and wheels.

Odd Safety Signal on Fender



AN automobile safety signal that operates on the principle of visible indications by means of illuminated cross-arms has been tested and approved by boards of safety of at least one large city.

The signal takes the shape of a Maltese cross with a light-bulb in each arm and in the center. In the daytime the transparencies show black when not illuminated, but when a signal is to be displayed the black is changed to the color of old-gold, which can be read one hundred feet away, even in bright sunlight. At night, when the contrast is greater, the same signals can be read for five or six hundred feet.

With all four arms and the center lighted, this signal warns other drivers that the car is to be turned around. There are nine combinations to indicate the intentions of the driver

A small hemispherical switch with two levers forms the signal mechanism. Any signal desired may be shown by a single movement. Placed on the left fender, the signal is visible to the cars ahead and to those behind.

A special code that in its various combinations informs other drivers of the next movement of the car, has been devised.

WHEN the Underwriters' Laboratories receive an automobile bumper for testing, it is mounted on a stripped chassis frame bolted to a concrete floor. A short length of 24-inch pipe filled with concrete and weighing about six hundred and fifty pounds is suspended by a 50-foot cable immediately in front of the bumper, pulled back twenty four feet, and released. The impact of the weight equals that of an automobile weighing two tons traveling four miles an hour, and the shape of the pipe simulates collision with a telegraph-pole. The effectiveness of a bumper depends on the security of its fastening. The tests seldom break the bumper itself.

AS a Special Service to Readers the Editor will be glad to furnish the names of firms manufacturing the interesting devices and accessories for motor-cars illustrated on these pages.

Whether the tempera ture be above or below [illegible] It is a combination of thermometer and hygrometer

A long lever [illegible] eliminates [illegible] possibility of your [illegible] choice

It is possible to exert a pressure of several hundred pounds with this pressure gun and increase only a slight turn of the crank is sufficient to thrust the grease to all parts of the bearing

This tire spreader is different from many others in the fact that tell metal fingers open the tire at points entirely around its circumference

When the [illegible] is shown by the jet of oil that [illegible] its arc and passes the mercury in the thermometer

The tire [illegible] are [illegible] in spectacle [illegible] while a pressure [illegible] foot lever spreads the beads of the tire wide open and expedites inspection

When You Want Expert Advice About Your Car

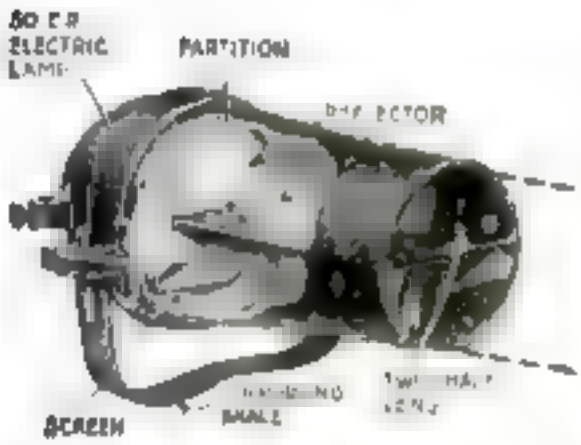
IN these six pages of ideas about automobiles and motor-trucks Popular Science Monthly endeavors to help its readers solve problems of maintenance and repair. But there must be special cases that are not covered, and we invite you to write to the Automobile Editor and let him advise you.

If you wish to know more about the devices pictured here, or if you want to ask questions, write. See a few typical answers on page 81.

The petty thief is frustrated if [illegible]

This new utility wrench with its four hexagonal openings be[illegible] used with every size of [illegible] lug

By virtue of its hinged, split frame construction, the front and rear wheels of this new truck can be turned at opposite angles, as pictured. The machine has the same speed and power whether going backward or forward

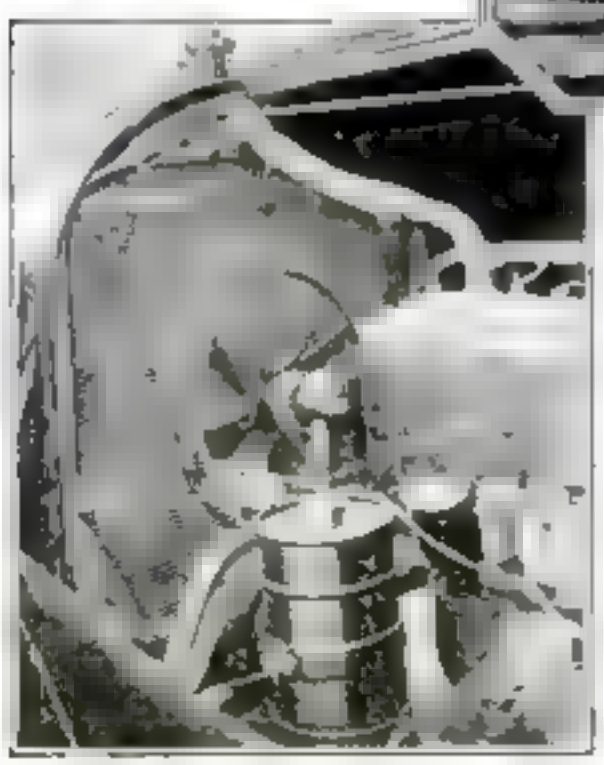


The new English anti-glare attachment pictured above in cut-away view can be [illegible] any headlight of [illegible] type [illegible] spherical [illegible] tion [illegible] the shoulder high

The most interesting development in the automobile world today is the increase of intercity travel in specially constructed "luxury" motor-buses. Read the remarkable article on this subject in Popular Science Monthly next month.

Steering column headlights of the above type can be tilted forward by a small lever [illegible] to protect the [illegible] of an oncoming car from the blinding rays

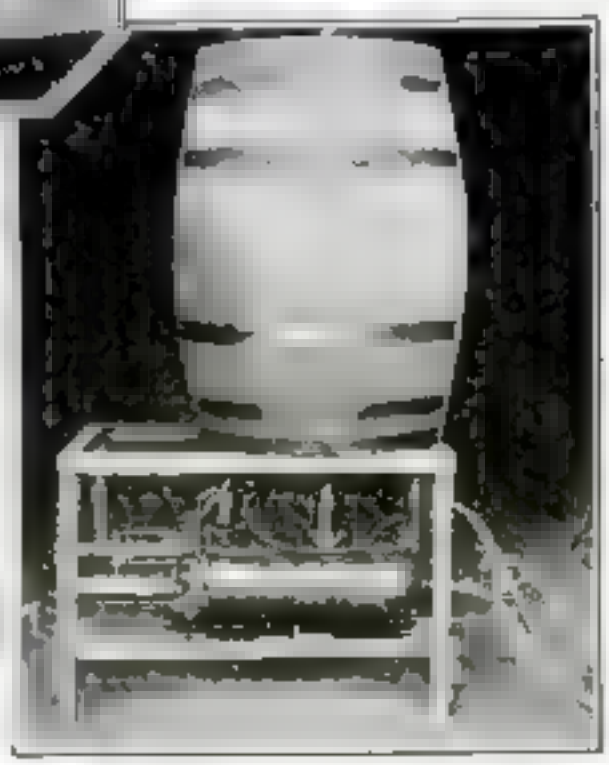
© Kadel & Herbert



This equipment, built on the vacuum-feed principle, keeps the automobile radiator filled by condensing and returning escaping steam. When leaks develop, a warning whistle blows

A new running board tool chest for motorists [illegible] of [illegible] trays, each with drawers [illegible] the appropriate tools [illegible] Placed one on top of the other, the trays are locked together by means of the steel band shown

The radiator will never freeze in overnight if the garage is equipped with this device. The motorist simply places it on the engine and turns the switch



With this compressed-air apparatus the garageman can dispense measured quantities of heavy lubricant direct from the original container. The hose connects to crankcase, differential, etc.

Why I Believe You Should Buy a New Car

It looks better, gives greater riding comfort, and has more labor-saving accessories than the used car

1944

By S. P. McMinn

NEVER before to our knowledge have the respective merits of the New and Used Car been exhaustively argued in print. Last month Popular Science Monthly published a motor expert's plea for the Used Car. On this page the other side of the argument is now presented. Winter is the time to buy used cars. The spring automobile shows will soon be here with their galaxies of new cars. These articles will help you form an intelligent opinion as to which type of car to buy.

IF I were to buy another car now, I should buy a new one, just as I bought a new one the last time, and the time before. I get far more satisfaction out of a new car than I could possibly get out of the amount of money I might save by buying an older one.

But my real reason for purchasing a new car would be a utilitarian one. I use my car in my business quite as much as I drive it for pleasure. Hence, I cannot be annoyed with the petty troubles that invariably complicate life for the average used-car driver. From a business point of view these annoyances represent time lost; and when I drive for recreation, delays to fix one thing and adjust another are a nuisance, and often an expense as well.

But my new car runs like the proverbial top from the time I step on the starter until I shut her off in the garage. I'm not worried with ignition wiring dropping off, with a gripping or slipping clutch, with faulty brakes or a grind in the rear end—all the results of some one else's careless or ignorant driving. I don't have to be eternally tightening nuts and bolts, or, as more generally is the case, chipping them off with a cold chisel and a hammer because the former owner never touched them and they have rusted solid. Of course some few minor adjustments are likely to be necessary after the first few hundred miles of driving. That's to be expected. But they are adjustments that are easily made by any one. And if the owner cannot make them or does not care to, he has always the manufacturer's service station to fall back on.

For remember, the new car is guaranteed by the maker for ninety days under a guarantee that the dealer causes to include anything that may prevent that car from giving perfect service. This takes in all those minor but necessary adjustments. The dealer is not only willing to give the service, but is anxious to do so, for his best advertising is word-of-mouth advertising—satisfied-customer advertising.

Tests show that in a used car imperfect combustion permits condensed gas to leak into the crankcase, diluting the oil

Thus, I place Freedom from Trouble high on the list of reasons why I will buy a new car next time. Freedom from trouble also means safety. I do not know, and have no means of knowing, in buying a used car, what parts may have been strained to the point where they are likely to let go and put my life and the lives of my passengers in danger.

And tires. Tires are among the most deceptive things about a car, particularly to the average person, who knows little or nothing about them. Often enough they fool the expert. They look al right, good for thousands of miles—generally, because the person who is selling the car has "doiled" them up to look tha way. But it is the inside of the tire tha' tells the story, and you can't see the inside Even if you could, you would have to take the car or leave it—with the tires it had or it

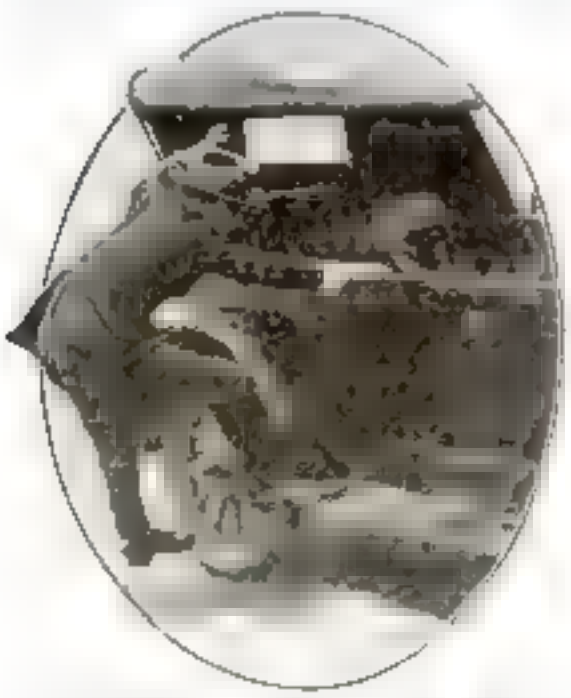
So you'd buy new tires—not right away perhaps, but before you had driven it ver far. Even if it is a very small car, four tires, not counting the spare, will cost in the neighborhood of $80 If you buy good cord tires which, by the way, are a real investment, then they will set you back about $120. Now add that to the original cost of your used car

But with my new car I have no tire trouble for thousands of miles. Punctures don't annoy me because the tires are so new that ordinary tacks and nails don't penetrate them. Blowouts are unknown. I roll along for 8000, 10,000 miles—I get better than 11,000 out of the tires on my present car—and literally don t know there is rubber under me

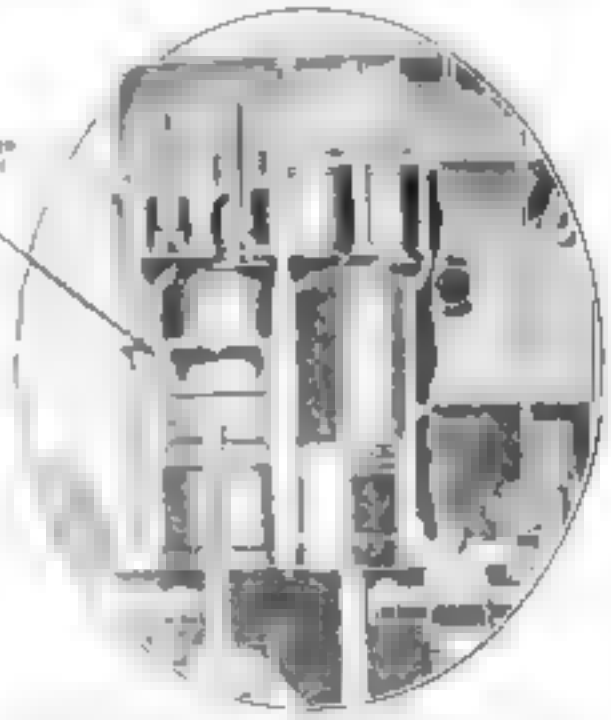
Another important reason why I shall buy a new car is because it is modern. Improvements are constantly being made in automobiles. They are not made for the mere pleasure of making them. They are necessary improvements. They are improvements that have to do with economy, flexibility, smooth-running and safety

On the score of economy alone a modern car is miles ahead of a car that is even so little as a year old. Our gasoline is getting worse every day. It's about al an old car can do to run on it at all. But my new car is designed from the ground up to use just exactly the grade of fuel I get everywhere all over the countryside. It is designed to use some of the heat of the burning fuel in order to make the rest of it burn economically—that is with the utmost efficiency

Then, too, unless the fuel is completely burned, it condenses and gets down past the piston-rings into the crankcase, where it dilutes the oil. The result is that this oil is used up far more rapidly than it should be, which means a big oil-bill. An even worse result is that the bearings and pistons are improperly lubricated. This in turn means sloppy pistons, worn rings, and perhaps scored cylinders. It may also mean burned-out connecting-rod or main bearings. That's one reason why all the oil companies advocate heavy oil for old cars. They simply allow for the dilution they know is occurring. Also, an important point to bear



Easy riding depends on spring design and suspension. The comparative resiliency of springs in new and used cars can be easily demonstrated as shown above



New cars have no scored pistons and worn piston-rings. Because of this, they run more silently, with lower fuel cost and greater reserve power

in mind is that the heavy oil quets an otherwise worn and noisy motor

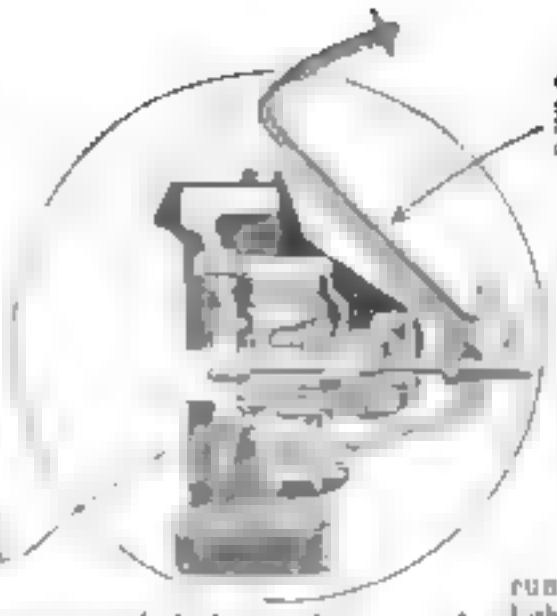
Then there is the ease of control. As I said before, I drive my car in my business and also for pleasure. As a business car it must not be unduly fatiguing to drive. And pleasure driving must be pleasure, not work. Old cars steer hard, due to faulty construction, to wear in the steering parts, or to lack of lubrication

Better design in my new car has brought about a proper proportion of the linkage and leverage and therefore it steers easily and requires little lubrication. What lubrication it needs is taken care of by a little jigger of a grease-cup to which I fit a big grease-gun, and force the lubricant where it ought to go—force out the old tired grease, and force in the new. Incidentally, every other part of my new car is lubricated in the same way A two-hour, messy, dirty job on an old-style car becomes a nice, clean, fifteen-minute job on my new one. And everything is lubricated properly.

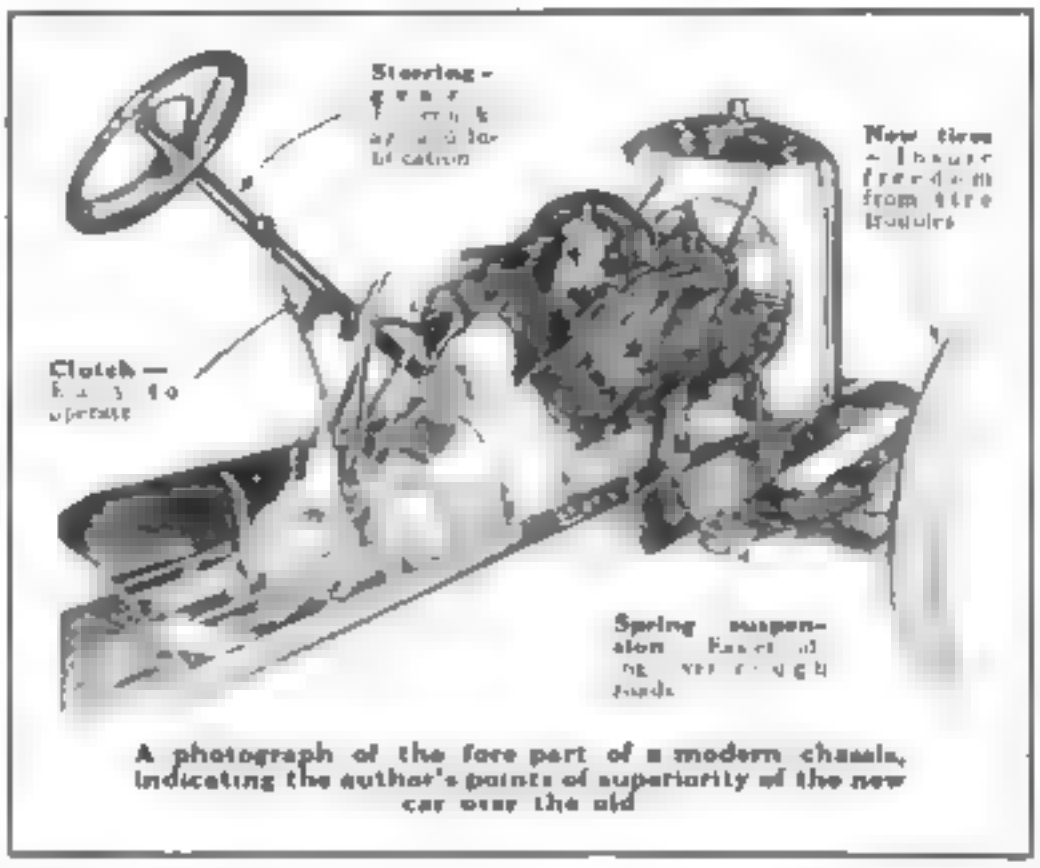
Clutch-springs are heavy in old cars, and so are the springs that hold the brakes off. This means leg strain It means a tendency to "ride" the clutch, and this wears out the clutch collar bearings in short order. On my new car, on the other hand, I can release the clutch with one finger and bring the car to a stop with the lightest imaginable touch of the service brake. The answer is summed up in better, more modern design coupled with better lubricating methods. They mean easy control. They make it fun to drive

And now look at the equipment I get with my new car

There are side curtains that open with the doors and really fit properly not jammed under the rear seat, wrinkled and torn and with half the celluloid gone They are put on and taken off as quickly They are not a Chinese puzzle even to my wife My new top is a one-man top, put up easily in a minute or two and folding compactly out of the way when I don't want it. My speedometer is geared to the gearset and so I don't have any trouble with fiber gears chewing up through their inability to chew up the road gravel they feed on. Nor does my speedometer cable freeze in winter and break, or run foul of a tire. My lights are modern and efficient. My demountable rims fit properly.



Better-proportioned linkage, lever- and clutch-springs make it possible to operate a modern clutch with less effort



A photograph of the fore part of a modern chassis, indicating the author's points of superiority of the new car over the old

On the score of materials that go to make up my new car I know that the maker has used vanadium and molybdenum steel so the parts may be made smaller and lighter, easier on tires and a miser for gasoline and oil.

For roadability and ridability my new car is far better than a used car. And my new car is a better investment than a used car, as witness my own experience. I bought a new car that cost me $1040, delivered. It came to me brand new, shiny, beautiful. It ran perfectly. I drove it for a little over a year, covering approximately 11,000 miles, and sold it for $850 cash. In that year I never had it near a service station, never stopped on the road for trouble of any kind, and never spent a penny for repairs.

Write to Us About Your Motor Troubles

If you have a motor-truck or automobile problem, let the Automobile Editor solve it

Advice to New Driver

Q.—I have just taken delivery on my first car What advice can you give me regarding driving or care of it? G. A. M. Tallahassee, Florida.

A.—As to driving, be twice as careful under all circumstances as you think that you ought to be. Keep your eyes open and use your imagination. Thus you should be able to foresee almost any road crisis.

Treat your car with as much sympathy as you would a thoroughbred horse. Never abuse it or neglect it. Above all, do not neglect its lubrication. If you give it plenty of oil and grease, it will last indefinitely. Inspect it once a month for loose nuts, worn insulation, etc

Never take anything for granted—a little scrap of advice as important as it is difficult to keep in mind

Horsepower Formula

Q.—Can you give me an accurate horsepower formula?—D. D. B., Fargo, N. D.

A.—There are so many variable factors in an automobile engine that no simple formula can be more than approximate On the average the following will give fairly good results:

$$\text{Horsepower} = \frac{D^2 \times N \times R}{2{,}000}$$

where D is the bore in inches N the number of cylinders, S the stroke in inches, and R the revolutions a minute

When Building a Garage

Q. What dimensions would you advise for building a private garage to house a single car? M. B. M. Peoria, Ill.

A. In building a private garage it frequently happens that the structure is cramped and poorly lighted. Good light and sufficient space around the car to permit of easy movement are essential. A margin of at least 2 feet should be allowed both at the sides and the rear The size of the average car is approximately 6 by 15 feet, so that the dimensions of the building should be 12 by 21 feet.

If the car is a Ford, the building may be reduced to 12 by 17 feet. A large car, such as a 66-horsepower car, should have a building 12 by 24 feet. There should be several windows.

Blowouts at High Speed

Q.—Why is a blowout dangerous at high speed?—M. D. McL. Oakland, Calif.

A.—A blowout in a front wheel is dangerous unless the steering-wheel is firmly grasped with both hands, this statement applies to all speeds in excess of about thirty miles an hour A blowout in either front or rear wheel is dangerous on a turn which is being taken at a fast rate, because it greatly increases the car's tendency to skid, and in many cases this increase is enough to cause an accident. If a car is running fifty miles an hour, and a blowout occurs in the right front wheel, the steering-wheel will be wrenched to the right and the car will swerve sharply in that direction unless the driver is prepared for just such an emergency The explanation is that no steering-gear is fully "irreversible," and the extra resistance caused by the flat tire rolling along the road swings the front wheels in that direction

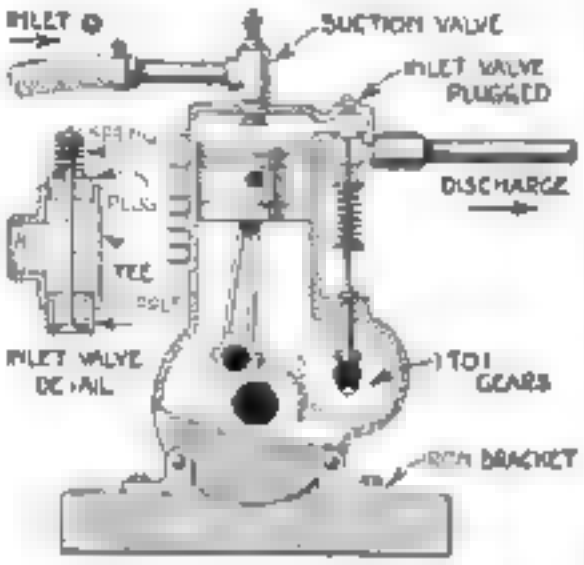
Most of the accidents blamed on defective steering-gears are caused by unexpected front-wheel blowouts.

Build a Homemade Water-Pump

By W. A. Logan

FROM an old motorcycle engine a suction water-pump may be built that will prove of great usefulness for many purposes. The timing gears of the engine should be undercut, instead of leaving them at 2 to 1. This change allows the discharge valve, which was formerly the exhaust valve of the motorcycle engine, to open at every up stroke of the piston.

The inlet or suction valve is made of standard pipe-fittings and is screwed into the spark-plug hole. This valve may easily be made at any plumbing-shop from standard ½-in. T, with an old valve-stem ground down to fit. The stem should run through a hole drilled in the plug that is screwed in the top of the T. The end of the stem is fitted with a spiral spring and cotter-pin. The spring should be of light tension, so that it allows the valve to open automatically as the piston descends, but closing it when the reverse stroke begins. At the same time the discharge valve opens and through it the water drawn in the cylinder is forced out.



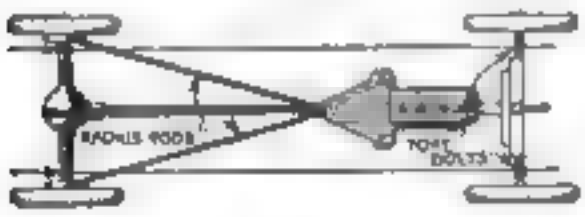
An old motorcycle engine may be restored to usefulness as a water-pump as here illustrated

It will be found that about 55 revolutions a minute is the best speed, giving approximately one impulse a second. The speed is calculated from the number of revolutions of the power pulley, its diameter, and the diameter of the pump pulley. The end of the suction hose should be provided with a screen to keep out the dirt that would interfere with valve action.

Adjust Radius or Torque Rods to Prevent Skidding

WHEN an automobile skids with the least cause and sometimes apparently without cause, the radius rods or torque tubes which hold the rear axle perpendicular to the center of the car are the reason. A bend or incorrect adjustment of one of these rods throws the center of the axle around and the wheels do not track, but tend to run in a different course. The rear end naturally inclined to follow the wheels and skidding is the result.

This is one of the seldom suspected causes of skidding and the remedy is to take accurate measurements from the yoke-bolts at each side of the front axle to the rear axle and adjust or straighten the rods as required until the measurements are exactly alike.—G. A. Lunde



Incorrect adjustment of the torque rods will cause skidding and should be remedied

Were You a Gipsy-Motorist This Summer?

DID you answer the call of the open road this year? Did the running-boards of the "old bus" groan beneath their loads of tenting, bedding, eatables, and utensils?

Tell us how much your trip cost, where and by what route you went, what big lessons you learned that will help others make plans for a similar vacation next year, and, finally, what automobile, camping equipment you purchased or improvised.

For the most interesting and informative letter, $35 will be paid, for the second best, $15. Letters must not be more than 500 words long and must be received on or before January 10, 1922.

Device for Spreading the Springs of Automobiles

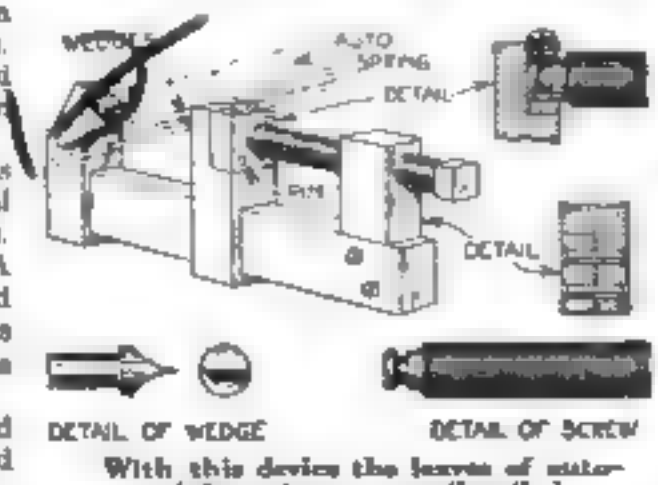
THE main portion of the device shown in the illustration is formed by a 14-in. monkey-wrench, the handle of which had been cut off with a hacksaw 6½ in. from the jaw.

Near the end from which the handle was cut, and at a right angle to the longitudinal axis, a rectangular groove is cut, 1 in. wide and half the thickness of the steel. A piece of steel, ⅝ in. thick, 1 in. wide, and 1⅞ in. long, is similarly cut at one end so as to fit in the groove near the end of the wrench-bar.

The two parts are then drilled and threaded for two machine-screws that hold them together. The free end of the set-in piece of steel is drilled and threaded for a ⅜-in. set-screw.

The set-screw has a square end fitting a key or wrench at one end, while the other end is turned down in the lathe and provided with a groove into which a round-headed machine-screw fits. The sliding jaw of the wrench is cut off square and cut out to receive a small block of steel, drilled to receive the blind end of the set-screw.

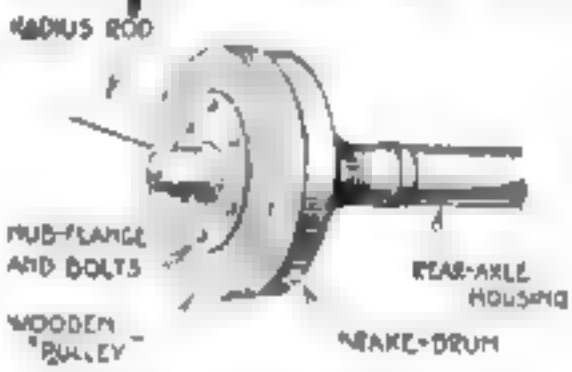
Two rivets hold the block and the jaw together and the round-headed machine-screw already mentioned fits into the groove of the set-screw. The two pieces that wedge the springs apart are made of ½-in. round drill-rod. The points are ground or filed to the shape indicated in the picture and then tempered.



With this device the leaves of automobile springs are easily oiled

Let Your Ford Help in the Farm Work

ON the small farm the possession of a Ford is a valuable asset. Its sturdy engine may be employed to furnish the power required for driving or operating a variety of farm machinery, from a simple hoist to a sawmill or feed-cutter. It is an extremely easy matter to harness the Ford engine to almost any mechanical task by providing for it a pulley as shown in the illustration.



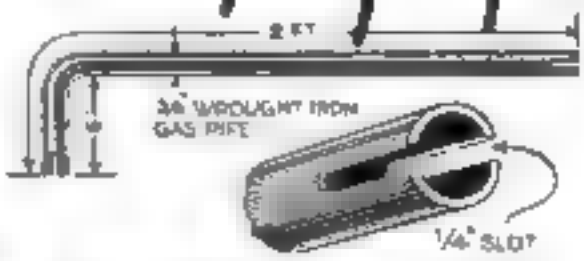
Attach a pulley to the rear axle of your Ford and it will run your farm machinery

Remove one of the jacked-up drive-wheels of the car and put in its place a pulley made of an old rear hub, a brake-drum and a circular wooden disk, 2 in. thick and of the same diameter as the brake-drum, all securely bolted together as shown in the picture.—E. A. Meagher.

Special Tool for Wing-Nuts and Petcocks

THIS tool for use in the garage while adjusting and oiling the car can be made of a 2-ft. length of gas-pipe bent at one end and slotted with a saw at both ends, as is shown in the attached sketch.

This tool obviates the practice of reaching or crawling under the car to turn up winged nuts provided for adjusting brake-bands or turning off stopcocks for the gasoline line or crankcase of the motor or the drain under the radiator or pump. The turning tool is also of advantage in turning up grease-cups of the type with a winged cup for the grease. This tool is readily made up in a few minutes and its use avoids soiled cuffs, coat sleeves, and clothing.

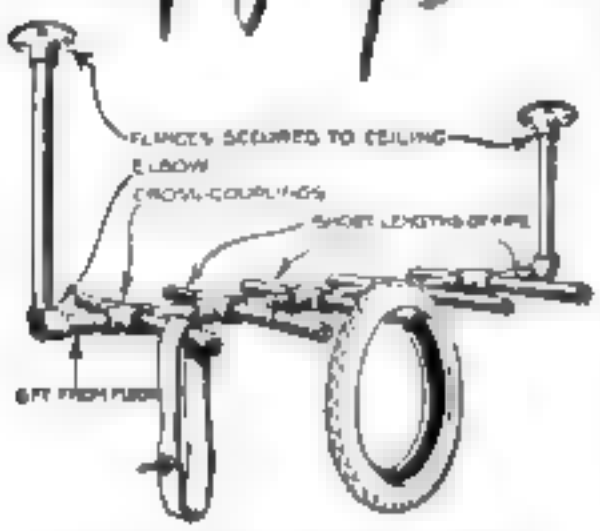


This tool will be found helpful for turning wing-nuts and petcocks

Shop Tire-Rack for Tubes and Casings

A RACK to hold tubes in the tire-repair shop is made as shown in the illustration from sections of light gaspipe and connectors. This rack compares with racks constructed of [illegible] the same price, but is far more convenient for [illegible] a tire or tube and in locating the desired tire or tube when called for.

The rack is suspended by means of flanges from the ceiling and elbows and cross couplings are used to screw the several sections of gaspipe together. This rack is hung about 6 ft. above the floor and consequently does not interfere overhead. It will hold a large number of tires and is practically indestructible.



This hanging rack offers many advantages in the repair-shop in which space is limited

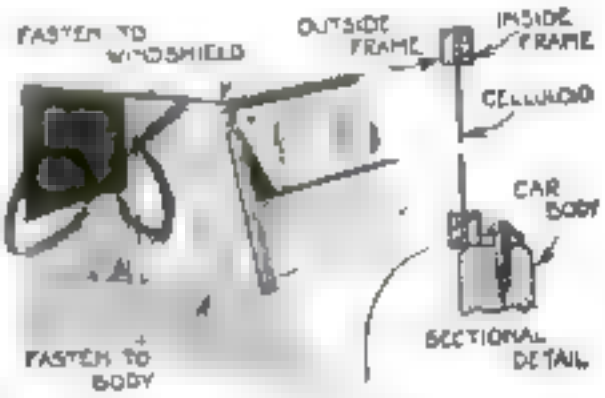
Auxiliary Wind-Shield for the Automobile

ONE form of auxiliary wind-shield which will protect the occupants of an automobile from rain and wind is [illegible] as shown in the illustration.

This shield consists of a sheet [illegible] in a brass frame screwed jointly to the [illegible] of the body adjacent to the [illegible] and to the wind-shield frame.

One of these shields is used at the side of the car and the side curtains are altered by extending the edges so as to fasten to the brass frames. With these a clearer vision is afforded the driver when the side curtains are in place. The transparent celluloid will not break and shatter as would glass, and when dulled it is renewable by separating the screwed brass strips. These shields are about 12 in. wide and made to correspond in height with the wind-shield.

The polished brass [illegible] the appearance of the car apart from serving as a frame for the celluloid. The freedom from the usual dust and dirt obviates the use of glass or goggles.



Riding in an automobile is made much more pleasant by an auxiliary shield against rain or snow

Keep Your Home Shipshape

Interesting things to do around the house to save time, temper, and money

Fire-Extinguishers for Use in the Home

SOME means of putting out fire should be kept in every room. The following formula will provide, for a trifling cost, material for twelve or more hand-grenades that will instantly put out fire.

Get 5 lbs. common salt and 2½ lbs. salammoniac. Dissolve in [illegible] water. Bottle this up in the [illegible] bottles you can find, cork very tightly, and place them where every one will be able to find them quickly, but not in too hot a place.

Should fire break out, knock the neck of the bottle off and sprinkle the contents over the fire, or throw the whole bottle into the fire against something hard with sufficient force to break it, and the fire will be extinguished.—E. A. McCann.

Softening Sponges without Injuring Them

FINE grades of sponges, sold under the name of "baby sponges" or "surgical sponges," are invariably free from grit and bleached with permanganate of potassium and sulphurous acid before they are placed in the market. It has been found that this bleaching process greatly diminishes the resiliency of the sponge fibers, making them soggy and difficult to clean.

It is, therefore, obvious that the unbleached sponges are preferable and more enduring, but they must be freed from the gritty particles which they contain before they can be used on the soft skin of the baby. These particles, which consist principally of carbonate of lime, may be removed without injuring the elasticity of the sponge by immersing it for two or three hours in water containing about five per cent of hydrochloric acid. After the sponge has been removed from this solution it should be thoroughly washed in several changes of running water to eliminate every trace of the acid.

Simple First Aid for the Alarm-Clock

WHEN the old alarm-clock lies down on the job and insists upon taking a rest in spite of your shaking and twirling, the trouble is generally that the cold has gummed the oil and put the brakes on some of the more delicately adjusted moving parts.

The cure is easy. Put the clock in the stove or on the steam radiator. Let it heat through thoroughly—of course not enough to melt the solder in the case or scorch the face—and the gummed oil will soften and run out of the bearings, leaving just enough to keep everything in the old stand-by working smoothly.—F. M. Weston, Jr.

How to Make a Cracked Bottle Watertight

FREQUENTLY we have a cracked cut-glass or other bottle of good quality which we should like to continue using. To mend it and make it watertight heat the bottle, cork it tightly, then paint the outside of the crack with sodium silicate or waterglass.

As the bottle gets cold the solution will be drawn into the crack and will make a fine, tight joint.

Putty Substitutes for Use in the House

GLAZIER'S putty is made from whiting and linseed oil. A good substitute may be made of flour and oil mixed to the proper consistency. If you have no linseed oil, some varnish or paint will do. In fact, paint is better, if of the right color.

A substitute [illegible] than putty when large holes or cracks have to be filled is paper wet and macerated in water and mixed with some flour and boiled. This, when dry, will be found to set almost as hard as iron.

Plugging Up the Nicks in Old Furniture

TO fill up the nick in that mahogany table, prepare a mixture of 8 parts beeswax, 2 parts yellow ochre, 2 parts whiting and 2 parts Indian red.

For more serious cracks, a mixture of shellac, beeswax, and resin in various colors may be bought, or the handy man may compound the mixture by melting in a tin or iron pot a cupful of common shellac, a spoonful of powdered resin and a piece of beeswax the size of half a walnut. For golden oak, add a teaspoonful of yellow ochre; for mahogany, the same amount of venetian red; for walnut, the same amount of brown umber.

After the substances have been thoroughly melted and mixed, the liquid should be poured on a clean surface to cool until it may be handled. While it is still quite warm, roll it into a stick between the hands. Apply to the cracks with a hot (but only black hot, not red hot) chisel.

The Home Workshop

New and Useful Things for the Practical Man to Make

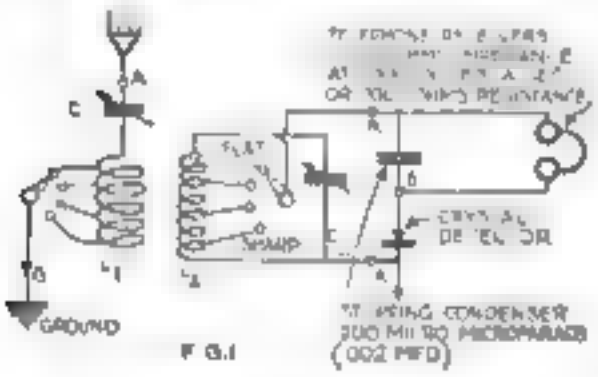
A Simple Radio Receiver for Everybody

By Arnold Holmes

DO you know the joy of receiving radio messages and radio concerts? Long wintry nights are ahead of us. Have you thought of sitting in your warm, comfortable room and bringing the news of the world to your ears? Nothing is more fascinating. You can do it. Only a few dollars and a few simple tools found in every tool chest are needed. Start now.

IN these times, when the Bureau of Markets is broadcasting daily reports of market conditions from a chain of stations all over our country, the naval stations are sending out weather and navigation reports, some commercial companies are operating radiophone stations, and thousands of amateurs are using both the radiophone and the radiograph, it behooves a good many of us to build receiving-sets, get into the game, and receive some of this valuable and interesting free information. A few dollars carefully spent will build a radio set that will bring the news of the world to our homes. It is possible that the market reports may be used in our business and the radiophone concerts that can be picked up nearly any night may take the place of our phonograph and have the added attraction that the music, though canned, is being transmitted through space from afar. It is interesting to listen to the small amateur station in your own home town talk to another possibly a thousand miles distant. This instructive hobby has proved an excellent diversion to many a great engineer and business man all over the country.

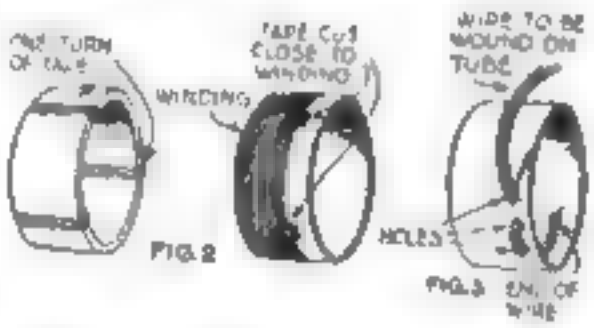
A simple receiver, having a wave-length range of from 175 to 750 meters and employing a crystal detector, will be described in this article. A novel means of connecting the crystal detector with the circuit so that extremely sharp tuning is possible, will also be described.



How the apparatus is connected for the reception of wireless messages

Before we can build a receiving set of any kind for a given wave-length range, it is necessary for us to know what sort of antenna we are to use, the kind and sizes of condensers that are available, etc.

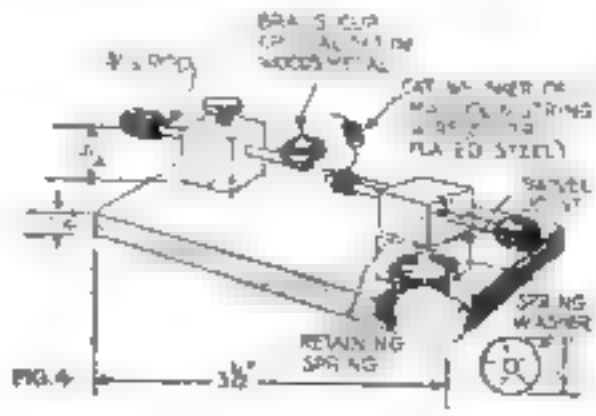
For the ordinary amateur the receiving antenna should be capable of being used for transmitting as well. For this reason we have chosen a T type antenna 35 ft. high and about 50 ft. long as the ideal. Of course, the receiver will operate equally satisfactorily on a larger or smaller antenna, but if the antenna is too large, it will be impossible to receive the shorter wave lengths, and if it is too small, the reverse will be true. Such an antenna as the one described will have a natural wave length of about 150 meters and a static capacity of about 400 micromicrofarads.



A few turns of tape about the tube will prevent windings from slipping

The end of the wire should be anchored in the tube as in Fig. 3 before the winding is started

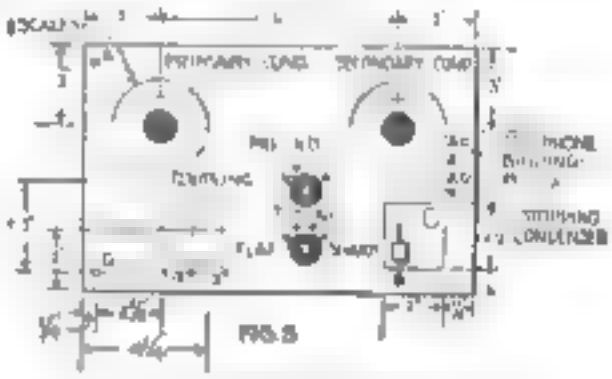
Since the receiver is only to cover the limited range of wave lengths between 175 and 700 meters, it is not desirable to use a condenser larger than 750 micromicrofarads capacity. A minimum capacity of not higher than 35 micromicrofarads (.000035 mfds.) should be obtainable in condensers of this size. With these values of minimum and maximum capacity and the coils suggested, the desired wave-length range can be obtained. It is then obvious that greater wave-length ranges can be obtained by using condensers with higher maximum or lower minimum capacities. The first table on page 85 lists a number of commercial condensers and their minimum and maximum capacities.



The details of the crystal detector used in connection with this outfit

Figure 1 is a schematic diagram of the receiver circuit. The wave length of the secondary circuit is determined by the inductance coil L_2 and the adjustment of the condenser C_2. The wave length of the antenna circuit is determined by the antenna, the inductance of the coil L_1 and the adjustment of the condenser C_1. The two circuits are coupled electromagnetically through coils L_1 and L_2. The coupling is variable by rotating the coil L_2 within L_1. The tuning of the circuit is made sharp or flat in part, by adjusting the coupling handle so that the coils are mutually perpendicular or parallel to one another.

The crystal detector is generally connected across the receiving condenser so that all of the voltage of the received signal acts on the detector. Physicists who have studied the crystal detector, tell us that it has a very high resistance for weak signals and a low resistance for loud signals. Thus the condenser C_2 is shunted by a very high resistance when weak signals or no signals at all are impressed on it and a relatively low resistance when strong signals are impressed on it. Shunting the condenser C_2 by a resistance has the same effect as adding resistance in series with the inductance and the condenser C_2. The lower the resistance, the greater the resistance thus added. Engineers have found that the sharpest tuning results when the resistance of the circuit made up of L_2 and C_2 is lowest. From this we see that the crystal detector connected across the condenser gives flattest or broadest tuning for the strong signal. If, instead of connecting the detector across the condenser C_2 or the coil L_2, it is connected across only a portion of the coil L_2, it will have less effect on introducing resistance in the circuit, and the tuning will be sharpened materially. In fact, with this arrangement, it is possible to obtain as good selectivity as can be had with the vacuum tube receiver. This method of connecting the detector to the receiving circuit is, in effect, loose coupling the detector to the secondary circuit.



How the apparatus is finally mounted on the panel

The coils can be wound on cardboard, or rubber tubing. If the set is to be very well made, it is desirable to turn a thread on the

tubing having the same pitch as that of the wire when wound close together. In winding coils on tubing of smooth surface material, the following kink will be found very useful: wind a single turn of friction tape around the tube longitudinally in three places (Fig. 2). This will hold the wire firmly and prevent it from slipping during and after winding. After the winding has been completed, the tape can be cut close to the winding with the aid of a penknife.

The wire can be fastened at each end of the winding by drilling three holes in the tube in line with the wire and winding it in and out as shown in Fig. 3.

The dimensions of the coils and the winding data, the capacities of the various condensers, etc., are given below.

For the crystal detector, any of the standard makes of stands may be used, and galena, radiocite, zincite, chalcopyrite, etc., used as the crystal. A satisfactory crystal-detector stand is shown in Fig. 4.

The crystal is held in a small metal cup by Wood's metal (a low melting alloy). The cup may be turned in any position by means of the knob and held in position by the set screw. The cat-whisker is adjustable by turning the handle or sliding the rod through the support. The brass spring is fastened to the support and presses on the cat-whisker rod so that it will stay put in any position. The rod is also capable of swinging on the swivel, which is made so that it will stay in any set position by means of the spring washer. In operating a crystal detector it is beneficial to occasionally wash the crystal with a little carbon bisulphide.

Usually panel mounting is the most satisfactory, because the panel can then be mounted in any convenient place.

A conveniently arranged panel is shown in Fig. 5. This arrangement allows the equipment (allowing for a 5-in. diameter condenser) to be mounted on a panel 10 in. by 12 in.

One of the possible arrangements of the coil mountings and details of the adjustable coupling feature are given in Fig. 5 for the convenience of the experimenter. With a set of this sort it will be possible to overhear spark stations, buzzer-modulated continuous-wave stations, and radiophone stations within the range of wave lengths specified.

COIL DIMENSIONS, ETC.

Condenser	Min. capac. 35 M mfds.	Max. capac. 750 M mfds.	Capacity
[illegible]	Stopping condenser		200 M mfds.

Coil	Tube dia.	Winding length	Total turns	Turns taken off at turns. Nos.
L_1	3 in.	[illegible] in.	105	20 40 60
L_2	3 in.	1¼ in.	60	15 30 45

CONDENSER TABLE

List of standard commercial condensers and their approximate capacity range

Manufacturer	Approximate Minimum Cap. M mfds.	Approximate Maximum Cap. M mfds.
De Forest		
[illegible] 1501	30	1600
Grebe Radio		
[illegible] A	20	670
[illegible] E	25	940
	50	1500
	60	3000
Murdock		
36A	20	500
36B	25	870
Nelle		
3500	20	640
31000	25	1100
3200	45	3300
West. Elec. Co.		
46 A.	30	740
47 A.	25	225
Cutler		
1	20	530
2	35	1050

How to Make a Pair of Delicate Balances

By Bert Rodson

TO construct with ordinary tools and from ordinary material a pair of chemical balances that will weigh the ink on this sheet of paper is not at all hard or impossible. So delicate a pair can be constructed easily from 4 ft. of No. 10 iron wire, 4 ft. of No. 16 iron wire, 4 phonograph needles, some small strips of 1/16-in. brass, and 2 small blocks of wood. The tools necessary are pliers, hammer, small center-punch, vise and soldering outfit. Having procured these implements and supplies, proceed as follows.

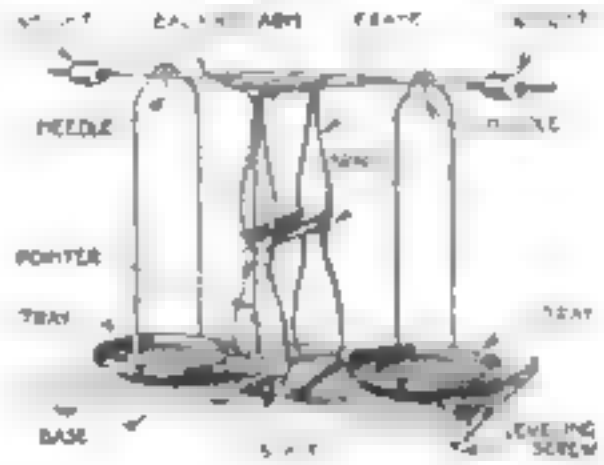
From the No. 10 wire carefully bend the form of the frame. The following dimensions are suggested: height 6 in., width of top 2 in., width of bottom 2 in. This frame should be bent by the aid of a vise and hammer. The two ends of the wire should be butted together and soldered under one of the curved ends of the bracing strips across the bottom.

When the bending is completed, the little stiffeners made from 1/16-in. brass 5-16 in. wide, should be bent and soldered into place. Two small holes should be bored in each of the bottom straps in order that the frame may be fastened to the baseboard. On the front side of the lowest cross strip a graduated scale should be marked. The most satisfactory way of marking is by means of engraving the scale in the brass strip itself. However, the scale may be made on paper and pasted to the strip.

Next in order are the balancing points, which take the place of the knives of the ordinary chemical balances. This is one of the most exacting details of the entire construction. These points, which are phonograph needles, are fitted in the top of the frame as shown in the detail illustration, and are held exactly vertical by a bit of solder. Now, screw the frame to a baseboard planed flat and sandpapered and supported by two stationary feet and one adjusting screw as shown.

The balancing arm is made from another piece of the No. 10 iron wire. It balances on the two needle-points and carries the weighing-trays. It is 10 in. long. The tray-balancing points are spaced 2½ in. on each side of its center.

On the under side of the arm, exactly in the center, is soldered a steel plate, 1/16 by ¼ by 2 in. The center-punch marks on the under side of this plate fit over the main balancing-points. The making of these two center-punch marks is the most delicate operation of the entire construction. The center of the punch marks must coincide within [illegible]000 in. the needle-points. A good method of procedure for the making of these indentations follows.

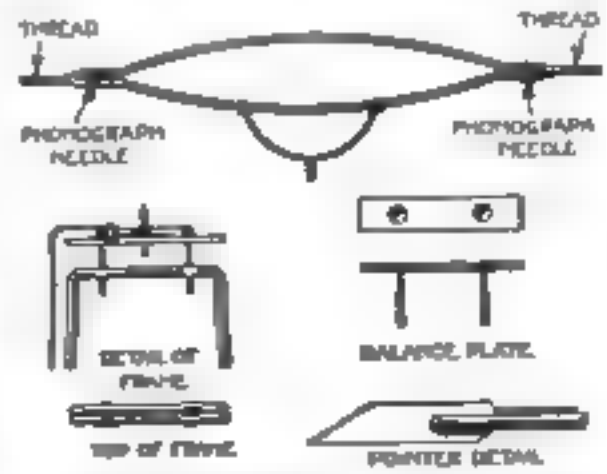


This shows the appearance of the balances when completed in accordance with the directions given

Procure a center-punch that has been ground to a very fine point and the point polished with emery-dust. Soften the piece of steel. (Brass may be used, but if so, the balances will not be as delicate.) Cover the side to be punched with chalk. Draw this chalked side across the needle-points carefully, in order not to blunt them or turn the points; then very carefully punch exactly on the fine lines left in the chalk and in the center of the strip. The center-punch marks in the strip and the balancing-points should then coincide exactly. Now harden the strip and solder it to the center of the top cross piece.

Next, insert the phonograph needles that are to carry the trays. Thread 1¾ in. of each end of the beam and screw a small weight on each. These weights will make it possible to bring the scales into perfect balance. Attach a point (made from two parallel No. 16 wires) as shown in the picture. At the end of this pointer insert a piece of very thin flat steel or brass. The edge of this strip next to the scale should be ground to a knife edge so that exact reading on the scale may be taken.

The weighing-trays may be made from metal, but they may be turned from the lid of a cigar-box more easily. They are hung on No. 16 wire brackets carefully bent as shown. On the inside of the topmost curve of each bracket is soldered a small piece of steel with a center-punch mark. The tray brackets then hang from the balancing points. If the brackets have been carefully made, the trays will hang exactly level.



The balancing arm is shown here in top view, also details of the most delicate parts of the structure

These balances will be found so sensitive that they should be operated in a room where no air is stirring. If the needles are perfectly sharp and accurately fit in the center-punch marks, and if the steel inserts in the top of the tray brackets are tempered until they are very hard, you will find no difficulty in weighing the amount of lead that rubs off of an ordinary lead-pencil in writing a half-page letter, or the amount of carbon dioxide taken out of the air overnight by a plant.

A good way to obtain small weights for your balances follows: Procure a thin sheet of aluminum and have it weighed exactly by a scientist or a druggist. If it weighs 100 grains, cut it into one hundred equal pieces and you will have 1-grain weights. Cut a few of these in half and a few in quarters. Cut, do not saw or file.

Useful and Attractive Ornaments from Carved Clay

By E. Bade

BEAUTIFUL as well as useful articles can be made of carved clay. The clay must be soft, like talcum, and under no conditions should it be gritty. A gritty clay is difficult to carve. The purer the clay the easier it is to work. It should have the least amount of foreign material in it. Only those pieces that are free from sand and pebbles are to be used; all other pieces must be rejected. But most important is its color. This may range from pure white to yellow, brown, lavender, and red, together with all intermediate shades. The variously tinted clays are more beautiful than the white, and the mixture of two or more colored clays is still better.

If the clay is so dry that it is difficult to mold, water should be added until it becomes very soft. When soft, two or more colors of clay may be worked together, which, when dry, will give the effect of marble. When this has been accomplished so that no air spaces remain, it is molded by pressing it into shape. The shape desired will, of course, depend largely upon the quantity of clay on hand and the desired object to be made. But it is always best to make blocks that are somewhat larger than the intended product. If a smoking-set is made, then the largest block, which is to hold the tobacco, can be hollowed out at once. This is best accomplished with a tin can. The other, and smaller blocks, are left as they are after they have been formed.

After the blocks have been formed, they are dried. This is best done in some warm room or attic. Care must be taken that they are left undisturbed for at least 6 or 8 weeks. Never place them in a stove, or otherwise bake them. This [illegible] causes them to crack. The slower the drying process, the better will the clay dry.

In carving the designs in the clay, you may give free play to your imagination and artistic gifts

When the blocks have become thoroughly dry, they are shaved down with a knife. When they have the desired dimensions and shape, the interior must be carved out, if this has not been done with a tin can. Here great care must be taken that the knife does not slip or that the corners are not chipped off. If octagonal jars or other containers are to be made, then the blocks are first squared, and after measuring the exact size of the corners to be cut off and drawing them with a pencil on the clay, they are slowly shaved down to the required shape.

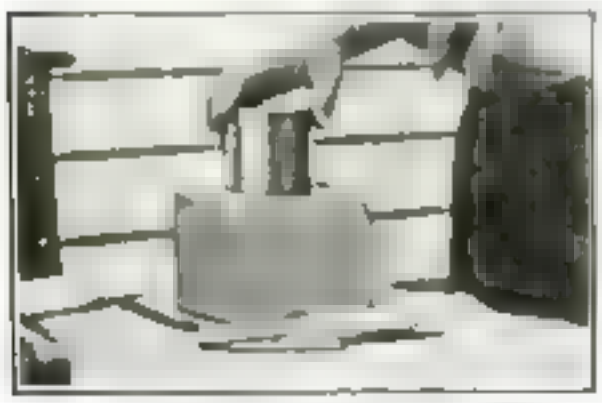
The cavitus in the blocks of clay can easily be made with a brace and bit or simply by turning the point of a knife on the block; but care must be taken that no pressure is exerted. After a small hole has been made, it can be enlarged with a pocket-knife until it reaches the desired size. Never make the walls too thin; it is best to have them at least 1/4 in. thick on small objects, and 1/2 to 3/4 in. on larger ones.

Now the most difficult and at the same time the most interesting work remains to be accomplished. That is carving. Since the clay, when dry, is very soft, it is a comparatively simple matter to carve. Formal designs are the most difficult to make. Here the straight lines must lie in certain positions, and if slightly on one or the other side, or if one end is slightly thicker than the other, the whole appearance of the object will suffer. Although at the first glance they seem to be more difficult, the simplest designs of all are leaves, branches, and tendrils; if one line does not lie in the position it is supposed to occupy, no harm is done.

The selected designs are first drawn upon the surface of the clay, and then the clay is removed on all its sides in small pieces, preferably as dust. The design itself should stand out in relief to obtain the very best effects.

When the object has been completed to the satisfaction of the worker, it must be covered with some kind of a varnish, otherwise the clay would come off at every touch. For this purpose celluloid dissolved in acetone is ideal, especially if the solution is made very thin. The acetone forces the celluloid into the clay before it dries, and when dry the surface will be hard.

It is best to give each object two coats, the second after the first is absolutely dry and no more fumes can be detected. Great care must be taken that the acetone is not brought near a flame, since it is very inflammable.



Here is shown the method of cutting out the well of the clay jar with a tin can of proper size

A smoking-set like the one above will be appreciated as a Christmas present by any smoker

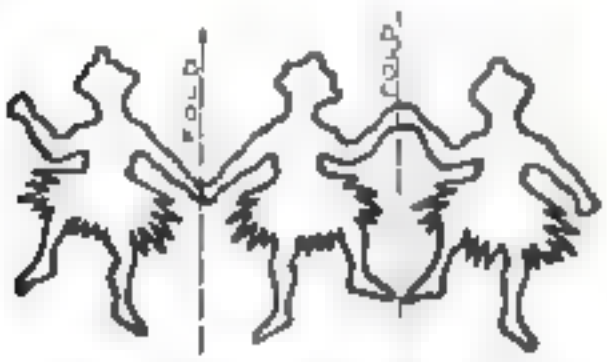
Moving Shadow-Pictures on the Screen Are Amusing

HAWAIIAN dancers, dancing animals, etc., shown in motion as shadowgraphs on a screen will form an attractive entertainment for children's Christmas parties. The figures of the dancers or romping animals are drawn on heavy manila wrapping-paper and carefully cut out.

The illustrations below give a number of suggestions for such figures and show how they may be cut out singly, in pairs, or in triplicate.

The spectators at the entertainment are all seated in the parlor. Over the door to the next room a large sheet is stretched. The lights in the parlor are turned down during the show. The figures are suspended by thin threads pinned to the sheet singly or in groups, and the entertainer holding in each hand a lighted candle, stands behind the curtain and moves the lights in rhythm with the music of the piano, thus producing the illusion of the figures dancing to the music. The illusion may be aided by giving a jerky motion to the sheet.

By arranging a program, it would be a simple matter to elaborate upon these dancers and to tell an interesting story with boldly defined cut-outs—in short, to produce a shadowgraph marionette show that would amuse the grown-ups of the party as much as the youngsters.



Draw one figure, fold the paper as indicated, and after cutting along the outlines you will have three figures

Moving the two candles in different directions with the music makes the figures seem to dance

Dancing lions, elephants, and other animals add to the comical effect of this shadowgraph entertainment

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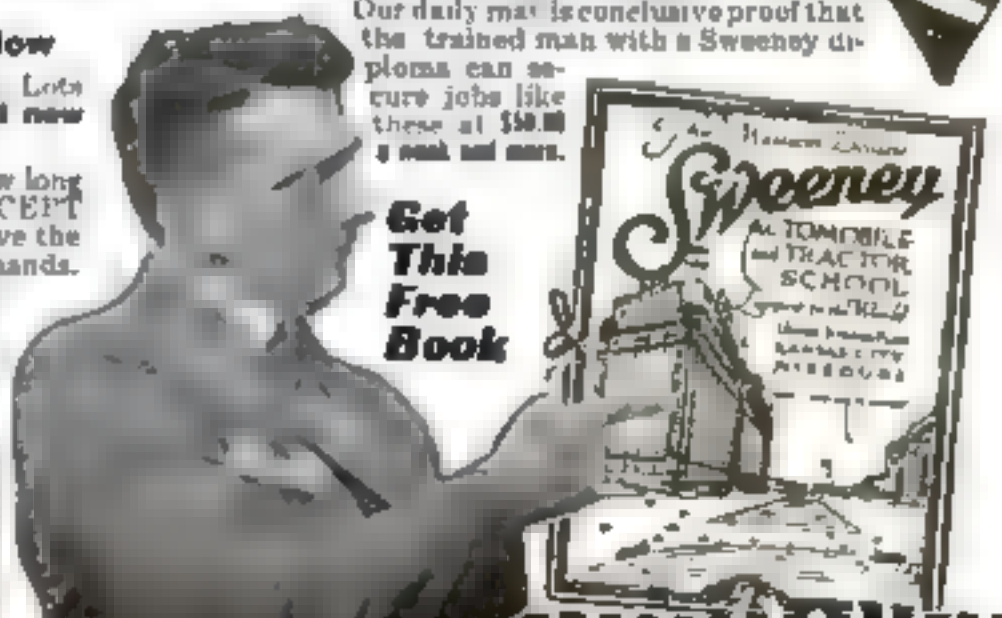

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Build Your Own Air-Driven Sled

By P. P. Avery

All aboard for a delightful trip through the crisp winter air with this propeller-driven sled

GOOD looking as is this homemade ice-flyer, it is not expensive, as it can be made from used parts that a mechanic always has lying around his workshop. Its novelty and speed will make a strong appeal to all lovers of outdoor sport.

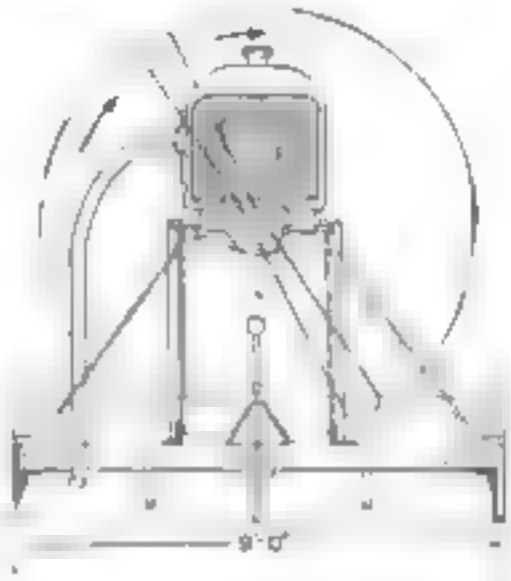
And now for the construction. First, look around for some spruce wood and from it build three 2-in. runners. Be sure that the spruce is well seasoned and that it has no knots in it. As soon as you have completed the runners, apply two or three coats of the best spar varnish.

For the motive power a good second-hand Ford power plant could be used. At the end of the elongated crankshaft is placed the 6-ft. propeller. The old Ford transmission is dismembered, all useless parts are removed, and sheet-iron plate is placed over the universal-joint housing.

The engine is set on an angle-iron foundation as shown. All unnecessary parts are discarded, such as the fan, for inasmuch as the radiator receives plenty of air. The exhaust pipe is elongated and carried to the back of the sled, as shown.

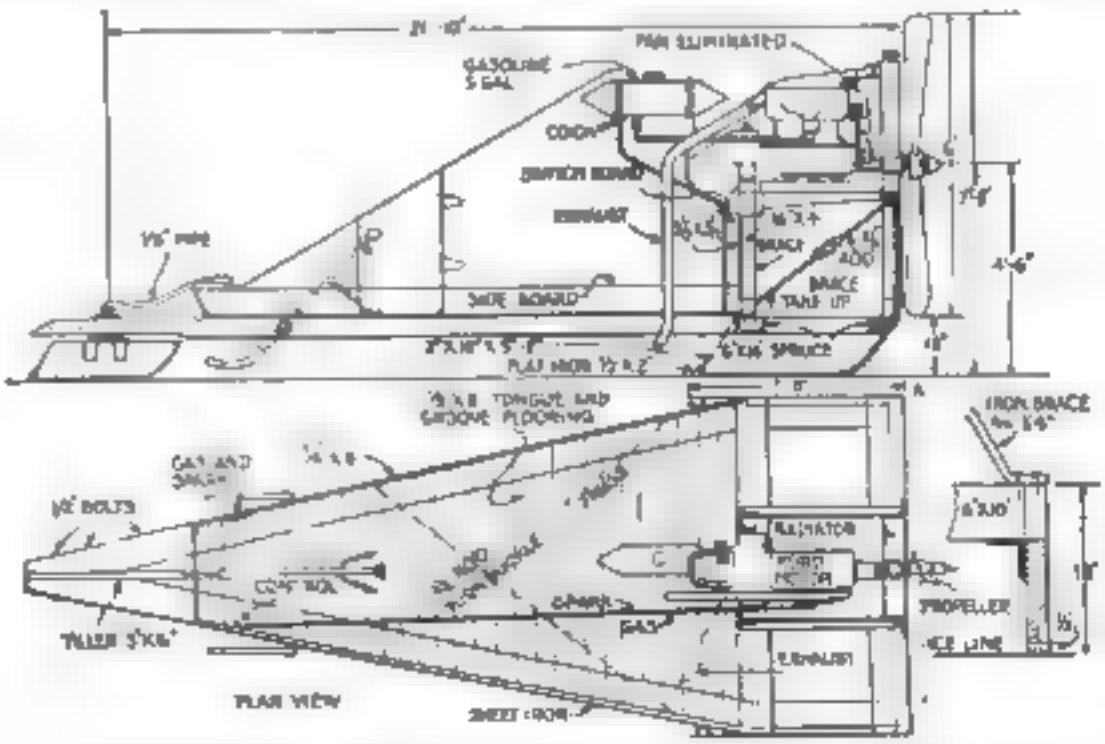
The frame of the air-sled is of 6 by 10 in. spruce reenforced by ½-in. bolts and corner braces all around.

The rear sled is for steering and braking. It is pivoted on a vertical axis that has a 1½-in. pipe handle. A strong spiral spring is placed around this steering-post, between the rear end of the platform and the steering-sled. This allows for unevenness in the ice surface. The side bands are of 1½-in. pipe and the flooring is nailed or screwed to the base. One-inch quarter-round strips are nailed along the edges. Battery plus magneto ignition is preferable to any other.

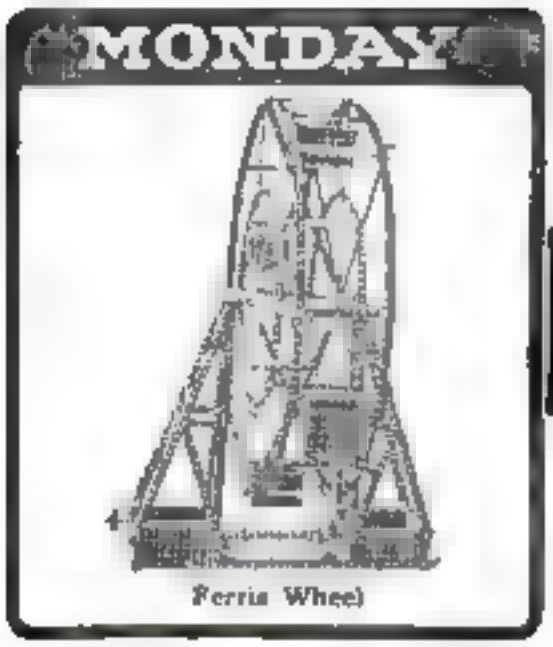


Front elevation of the air-driven ice-sled, showing the framework supporting the engine

When finally you have completed the sled's construction, the body should be given two coats of the best spar varnish and two coats of American white lead on all other parts. A gray and black striping for the floor and the runners will give your new conveyance a professional finish.



Side elevation and top view of the sled are here shown. The dimensions given are merely tentative and may be changed to suit conditions



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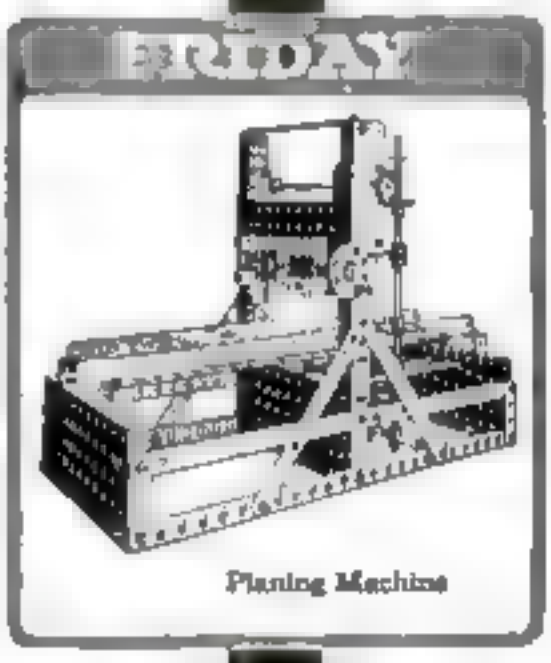

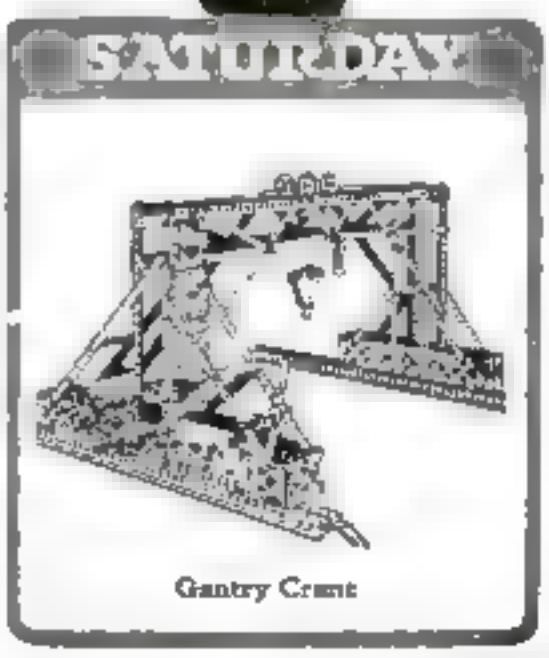

$1250 PRIZE CONTEST

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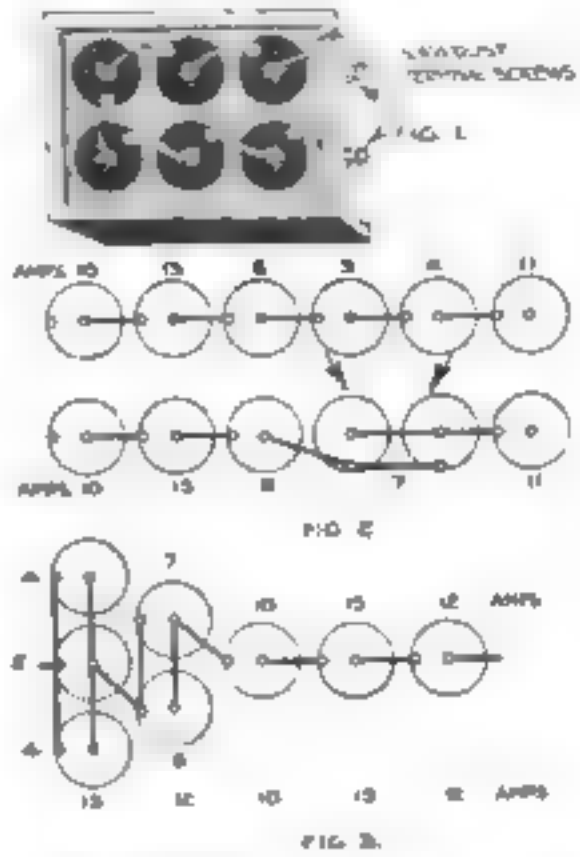
About the Care of Dry Cells in the Country

By A. J. Christopher

DRY cells, whether for one purpose or another, are used in almost every country place. They make the spark that lights your gas and runs your engine, they ring your doorbell, operate the burglar alarm, and perform other duties too numerous to mention

Dry cells should be kept dry and clean and slightly warm in order to give satisfactory service When they are purchased, it is well to give the batteries a coat of shellac or varnish so as to make them as damp-proof as possible and to prevent corrosion on the outside The paper containing should be replaced, to further protect the batteries.

Cells that come in units of three or more are sealed in a pitchy compound to eliminate moisture, loose connections, and short circuits. If it is desirable to make your own "units," make light boxes large enough to hold the cells and line them with heavy paper Place ½ in. of dry sawdust on the bottom and put in the batteries. With a wooden stick pack in all the sawdust you can to the top of the cells and connect them with No. 14 insulated wire, making sure that the wire is scraped clean and that the nuts are tight. Use the pliers for this. Then finish filling the box, fold over the paper, and attach the wire leads from the batteries to two binding-posts placed near the top on one side of the box. The cover may now be fastened. A piece of "strawboard" placed beneath and above the cells would act as a shock-absorber and would provide an air space, but it is not necessary. The box may be painted. The batteries will last much longer if protected in this manner



Several methods of connecting dry cells that will prolong their life are shown here

For the gas-lighting coil, four to six cells in series are usually used, and for engine ignition from three to ten. In this work they function properly only until one or more drops below five or six amperes These run-down cells then cause resistance in the circuit and the coil, not receiving the proper amount of current, cannot produce a fat spark. When the dry cells that operate a coil seem to be weak and, upon testing one or two, are found to be below normal, connect the two weakest cells as shown. Unless they are entirely exhausted they will give a little more service

A number of partly run-down cells may be connected in multiple series and will last a while longer. On farms where gas is employed for lighting, each building or group of buildings has its batteries and coil About once a year these batteries are replaced. Those removed should be tested. All showing four amperes or better should be kept and connected in multiple series. Always arrange them so that each cell or multiple of cells placed in series test around ten amperes. When connected in this manner, batteries that would otherwise be discarded will give service for from two to six months on a gas-lighting circuit.

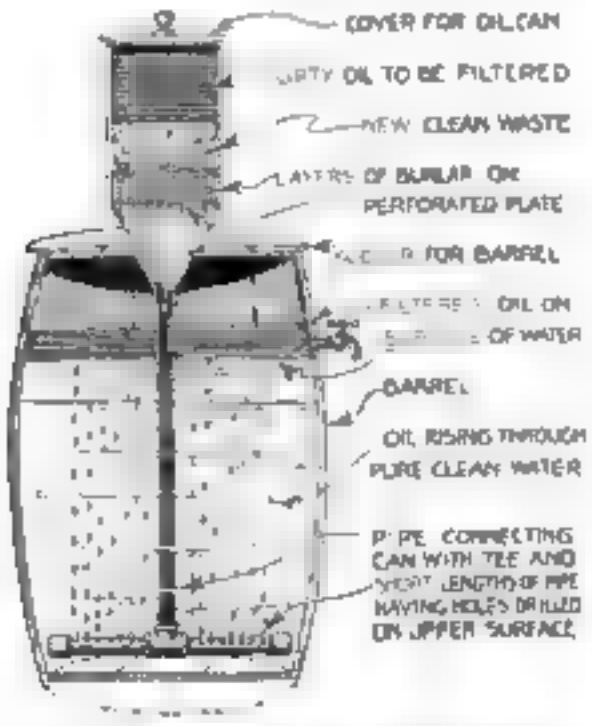
An ammeter test, if taken from the leads of the series-connected batteries, is unreliable, as it does not show a weak cell if one should be run down. Each cell, therefore must be tested individually.

Oil-Filter for the Farm or Shop

EFFICIENT and handy is this filter for oil. It can be made in the farm workshop from an ordinary wooden barrel, as shown in the accompanying illustration

The head is removed from a barrel and a cover is made to take its place. A circular hole 8 in. in diameter is made in the center of this cover. A 5-gal. round, conical top oilcan, in an inverted position, which serves to feed the oil to the filter, is placed in this hole The bottom of this can is cut out smoothly and is perforated with small holes made by the point of a small nail. This old can bottom is then dropped into the can and rests on the flare of the conical top.

Into the mouth of the can is soldered a short piece of small-sized iron piping to which tubing that extends near to the bottom of the barrel. To the threaded end of the pipe a T is screwed and a short piece of the same size piping is threaded into each side of the T to extend horizontally almost to the walls of the barrel. In the upper sides of these short pieces of piping are cut several small holes for the escape of the oil. The ends of these short pieces are plugged up with cork stoppers.



Every farmer who uses machinery may save money by constructing and using an oil-filter like this

On the perforated plate in the oilcan several layers of felt or burlapping are placed. On top of the burlapping is laid a bunch of new, clean waste, as shown in the illustration. This fills the can about half full and the remaining space receives the oil. The oil is then poured in on the waste in the top of the inverted can.

The barrel is filled two thirds full of pure, clean water and is provided with a bibcock that is 1 in. above the level of the water in the wall of the barrel. A cover is made for the top of the oilcan. It is obvious that the oil seeps down through the waste, through the burlapping and the perforated plate by force of gravity. Thence it descends through the perpendicular pipe out through the short, horizontal pieces of piping attached to the T union and emerges, a drop at the time, from the small holes made in their upper sides, rising to the surface of the water in the barrel, which helps to refine and clean the oil.

As soon as enough oil has been filtered to rise to a level with the bibcock in the side of the barrel, it may be drawn off as needed. The supply of waste and burlapping can be replenished with little difficulty when it has become polluted with foreign matter.—L. M. JORDAN.

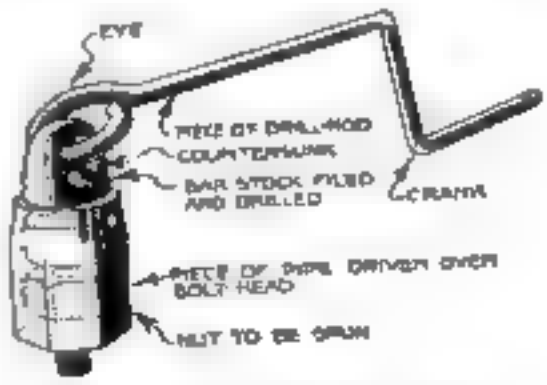
Shopmade Speed Wrench of Simple Construction

A SIMPLE form of jointed speed wrench for a small shop is worth duplicating, being of especial advantage in getting around almost any form of interference due to pumps, wires, and pipes. This wrench is not used to start or finish the bolt turning, but is for the express purpose of spinning them off

A heavy open-end wrench is used to start the bolt and this speed wrench is slipped on, when a quick job of removal is made. To make the wrench, use a 1- or 1¼-in. length of pipe. Drive this over the bolt head and flatten up the sides to a fair fit.

Use a piece of round stock and after drilling through one end counterbore from each side and round the end over as shown. Rivet this to the socket Make the handle as shown with a crank end and an eye on the other the eye made in the socket plug

To use, hold the handle in the left hand and turn the crank with the right. This wrench is particularly useful for removing cylinder-head bolts, especially those of a V-type eight- or twelve-cylinder motor



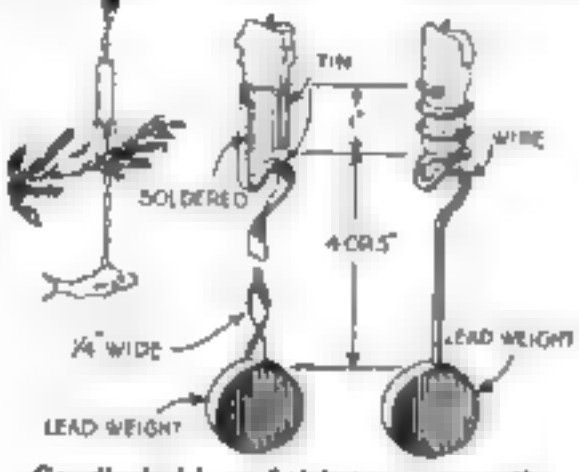
Here is shown a simple form of a homemade speed wrench which will be found very useful

THE HOME WORKSHOP

Christmas-Tree Candle-Holders that Always Hang Vertically

FOR the Christmas tree, here is shown an easily made candle-holder that will hang upright anywhere on the tree.

It can be made of wire or tin plate, with lead or babbitt weights to hold the candles



Candle-holders of this type are easily made and will always hold the candles in vertical position

upright. The weights can be cast in many designs, such as fish, or other animals, fruits, etc. They can be cast in plaster of Paris molds direct to the holders and may be painted with gold or aluminum enamel.—LOUISA A. CAPPEL.

Build Your Woodbox Under the Stairs

NEAR the dining-room stove is a woodbox that is large enough to hold wood for the entire day, and it is never in the way, since it occupies a space that was formerly unused under the lower part of the stairway.

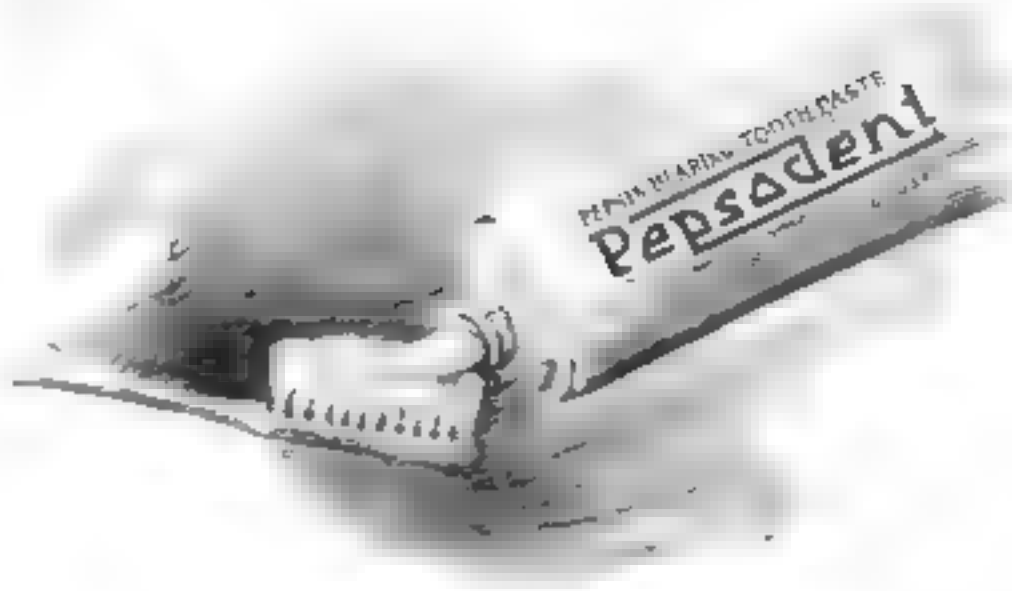
A small door in the living room wall gives convenient access to the wood.

The box is filled from the foot of the stairs. This is made possible by removing

A woodbox under the stairs will make the housework easier for the housewife

the entire fifth step and the top or horizontal section of the fourth, and fastening them together securely with screws and iron strips, bracing and reenforcing the corners both inside and out. This is the lid of the woodbox. It is hinged in place. Strong wooden supports were nailed to the wall on either side for the steps to rest on when the box is closed

To prevent falls and accidents on the stairs, the lid must be kept closed except when the box is actually being filled. So the lever shown in the line drawing is to open the box when stepped upon and to permit the box lid to close automatically when the foot pressure is removed.



This New Way

Now beautifies teeth half the world over

Millions of people, half the world over, now clean teeth in a new way. Modern authorities approve it. Leading dentists everywhere advise it.

This is to offer a ten-day test. The results will surprise and delight you. And they may lead, for you and yours, to life long benefits.

Write for this free test.

That dingy film

That viscous film you feel on teeth causes most tooth troubles. It clings to teeth, gets between the teeth and stays. It dims the teeth and often leads to ruinous attacks.

Film absorbs stains, making the teeth look dingy. It is the basis of tartar. It holds food substance which ferments and forms acid. It holds the acid in contact with the teeth to cause decay

Millions of germs breed in it. They, with tartar, are the chief cause of pyorrhea. Also of many diseases

Old brushing methods do not end that film. So very few people have escaped some form of film attack.

Now ways to combat it

Dental science, after diligent research, has found two film combatants. Able authorities have proved their efficiency. Now peoples of many nations use them daily, largely by dental advice.

The methods are embodied in a dentifrice called Pepsodent. And a 10-Day Tube is being sent to every home that

Watch these five effects

Pepsodent does more than fight film. It brings other results now believed essential, in view of the average diet

It multiplies the salivary flow. Nature's great teeth-protecting agent. It multiplies the starch digestant in the saliva—put there to digest starch deposits that cling. It multiplies the alkalinity of the saliva—Nature's neutralizer of the acids which cause decay.

Pepsin is also included.

This ten-day test will 20 times repeat all the effects. And you will gain a new idea of what clean teeth must mean

Send the coupon for the 10-Day Tube. Note how clean the teeth feel after using. Mark the absence of the viscous film. See how teeth whiten as the film-coats disappear

You will always want your teeth, we think, kept that white, safe and clean. This is too important to forget. Cut out the coupon now.

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The New-Day Dentifrice

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Ten-Day Tube Free 171

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Chicago, Ill.

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Only one tube to a family

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Five great big volumes bound in genuine American Morocco with 2,000 pages and hundreds of illustrations and diagrams. It is the most complete, most practical work of its kind ever published. Twenty-five well known experts prepared these great books, gathering the material from hundreds of different sources. Every man who has ever had to do a job of carpentry should have them.

The old days of hit or miss experience are passed. You have got to know if you want to keep in the running now. A little of your spare time and the Cyclopedia of Carpentry and Contracting will put you way ahead of the rest. Send for our FREE trial offer and easy payments plan below.

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City State

Reference

Please fill out all three lines

THE HOME WORKSHOP

New Prize Contest

"How I Made Money with My Tools"

HAVE you ever made extra money with your tools? If you have, we want to know just how you did the trick. If you constructed something, describe it. If there is a particular job that you do, let us know what it is. For instance, we have heard of a chap who mends furniture in his neighborhood during his spare time. Others have established small spare-time businesses with tools as their only investment.

Sit down now and describe your own experience for the readers of Popular Science Monthly. If you have photographs or drawings of the things you have made or the job you do, send them along.

Tell your story as humanly and interestingly as possible.

$90 in Prizes

Popular Science Monthly intends to make this worth your time. If you do not win one of the three big prizes it is possible that your article will be bought at space rates. First Prize will be $50; Second Prize, $25; and Third Prize $15.

Conditions of the Contest

(1) Contestants are not limited in the number of ideas. The contest is open to everybody.

(2) If a drawing is sent in, it need not be made by a skilled draftsman. The contestant's name and address should appear on each sheet of drawings.

(3) Drawings and photographs must be accompanied by a description, preferably typewritten, in which the subject is clearly explained. The MSS. must be written on one side of the paper only, and should not be more than 500 words in length.

(4) Drawings and descriptions entered by contestants must be received by Popular Science Monthly not later than 5 p. m., on January 20, 1922.

(5) The judges of the contest will be the editors of Popular Science Monthly.

(6) The first prize of $50 will be awarded to the contestant who, in the opinion of the judges, has suggested the best idea.

The second prize of $25 will be paid to the contestant who submits an idea next in merit.

The third prize of $15 will be paid to the contestant who submits an idea third in merit.

(7) The winners of the contest will be announced in the earliest possible issue of Popular Science Monthly and their articles will appear later.

(8) The editors of Popular Science Monthly shall have the right to publish meritorious manuscripts that do not win a prize. The regular space rates will be paid to the contestants who submit the manuscripts thus selected.

(9) Manuscripts or drawings will be returned to contestants if stamps are enclosed.

(10) Send drawings and specifications to the Editor of the Making Money with Tools Contest, Popular Science Monthly, 225 West 39th Street, New York City

Bench-Hook and End-Wood Planing Device

WHOEVER has attempted to plane the ends of small thin strips of wood will appreciate this handy little device. It is constructed of hard wood.

B is a block of wood cut like a miter-box, which is screwed and glued to the body *B*. This block also serves as a support when planing.

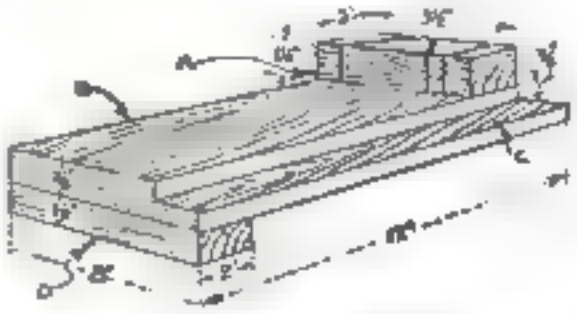
B is the body upon which the board to be planed rests.

C is a flat groove cut from *B*, in which the plane slides back and forth.

D is a support that is screwed and glued to *B* to keep the bench-hook from sliding all over the bench when used.

To plane the ends of a piece of wood, place the wood on the body *B* and against block *A*, then lay the plane on its side so the cutting edge is vertical. Then push the plane against the wood to be cut, pushing from you. The plane slides in the groove *C*.

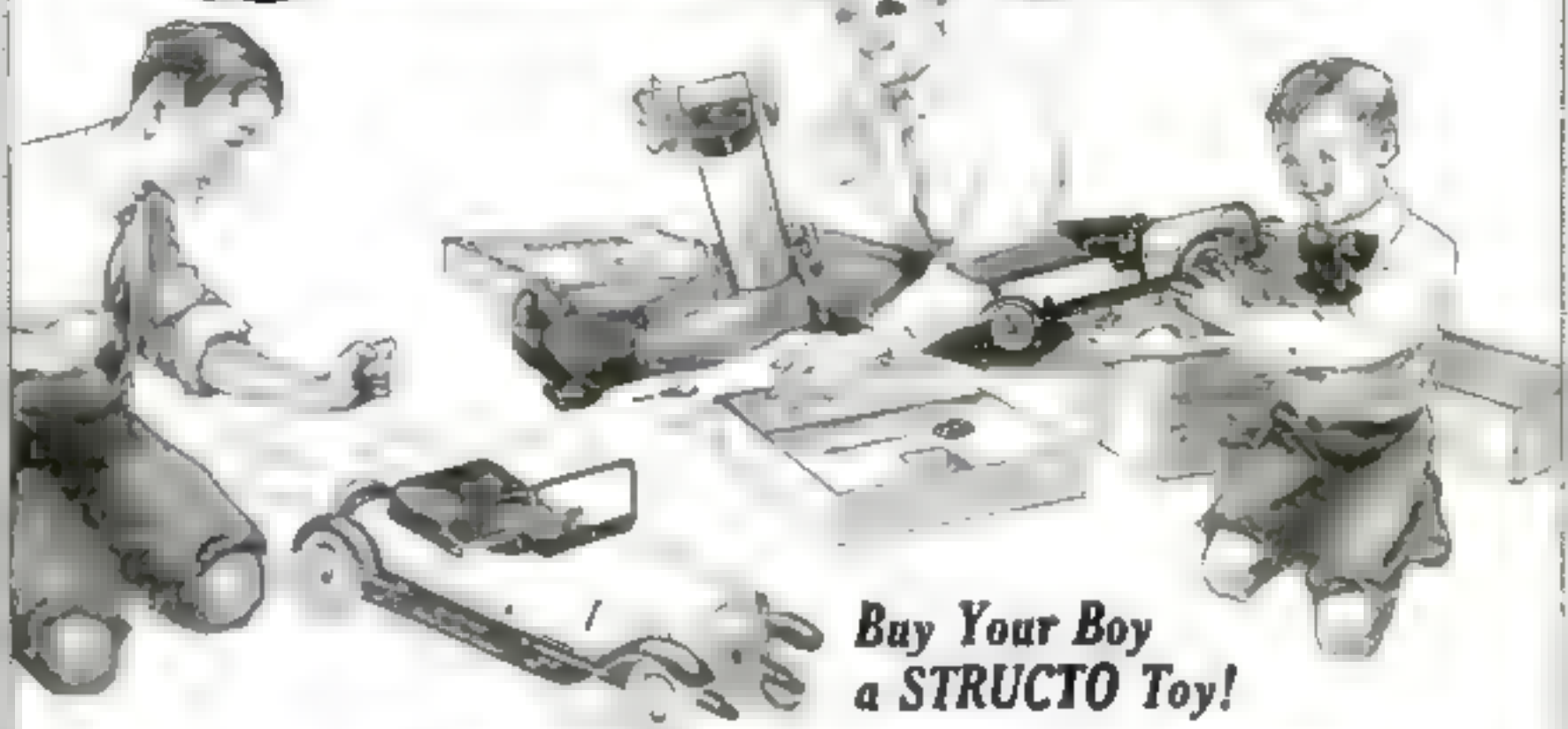
A screw-eye can be placed in the top of the body *B*, so that the device may be hanged on the wall when not used. The illustration gives the dimensions.



This little device on your workbench will make it easy for you to plane the ends of small strips

STRUCTO TOYS

MAK[illegible] OF BOYS



Buy Your Boy a STRUCTO Toy!

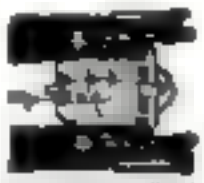
Build Structo Autos that Look and Run Like Real Cars!

Structo Racing Auto Auto Builder Outfit No. [illegible] A fast speed [illegible] in long. Green color, black trimming. $[illegible]

BUILDING a STRUCTO Automobile, Truck or Tractor is fine sport for any boy. These toys are remarkable replicas of real automobiles. They have motors like real cars. You seem to be put to work and build your own Auto, Truck or Tractor. You will [illegible] Racing Car or a sassy Roadster, a big Dump Truck or a sturdy Tractor. STRUCTO models are fine toys. They have strong powerful motors that [illegible] straight ahead or [illegible] a steep up-hill or on the level. Some have rolling gear trains [illegible] and reverse. Big car differential with gear and brake levers, [illegible] Tractors have direct connected gears that give [illegible] power [illegible] work. They all have many features of real cars, and are handsome [illegible] machines you can have a lot of fun with. They are so well made they last a long time.

Structo Sear Cat Auto Auto Builder Outfit No. [illegible] A stately powerful [illegible] 6 in long, [illegible] motor, direct shaft drive, [illegible] Red color, black trimming. $7.50

There are six fine models to choose from. Nos. 8, 10, 11, 12, 14, and 16 as pictured here. Any boy can build them all, the work is done. Just put them together and you have an Automobile, Truck or Tractor that looks and runs just like a real one. Look over these models, read the specifications for each one and decide which you prefer having. Any fellow who will be plain [illegible] you can build a STRUCTO Auto because it helps him understand how real autos are made.



Just like a Real Car! The No. 12 Model has [illegible] All these models have parts like the real thing.

There are also four dandy Ready-Built STRUCTO models, Nos. 40, 41, 43 and 44. These are ready built, fast and ready to run when you get them. They are [illegible] and have strong motors [illegible] The Cater-[illegible] No. 44 Tractor and No. 45 Tank are very realistic and [illegible] Each one comes in its own box.

Structo High Wheel Tractor [illegible] for Builder Outfit No. 11. Triple-unit motor, [illegible] powerful tractor of [illegible] red wheels. Tire roller included. $7.50 With Trailers $1.00 each

Ask for STRUCTO TOYS in the Toy Department, Hardware Store, Toy Store and any store where good toys are sold. Be sure you see the name "STRUCTO TOYS" on the box because then you'll have the best toys. If you cannot find the one you want we will fill your orders direct, upon receipt of price listed.

Structo Dump Truck Truck Builder Outfit No. 4. Triple-unit motor, sliding seat, chain-driven, forward and reverse gears, 16 in. long, [illegible] dumping attachment. Red color. $12.00

STRUCTO MFG. CO., Freeport, Illinois

Roadster Auto Ready-Built Model No. 40. A strong, speedy car, 10 in. long. Red with black trimming. $2.50

West of Denver, Colorado, and in Canada, prices are 10% higher.

Contractor's Dump Truck Ready-Built Model No. 43. Has both lifting and lowering [illegible] 12 in. long. Green with black and nickel trimming. $4.25

Caterpillar Tractor Ready-Built Model No. 41. [illegible] in. long, very realistic in action. Tow bar, [illegible] Green and red with black trimming. $5.00

Caterpillar Whippet Tank Ready-Built Model No. 45. 12 in. long. Gray with red trimmings. Gun mounted in turret. $5.00

Structo De Luxe Auto Auto Builder Outfit No. 12. Just like a real car. 18 in. long. Triple-unit motor, [illegible] transmission and differential, clutch and brake levers. Two steels forward and one reverse. Disc wheels, low body and other regular car features. Orange and black colors. $10.50

Tube Tractor Tractor Builder Outfit No. 6. A perfect reproduction of a well-known tractor. Powerful double-unit motor, [illegible] handle and [illegible] steering lever. Tire trailer included. 20 in. long over all. Blue and red color. $8.50

$500 REWARD for TWO HOURS WORK

In answer to a request from Chief of Police Wilson [illegible] Finger Print Expert [illegible] one of the [illegible] officers. $500.00 in [illegible] was given. Not a single clue had been found.

A [illegible] immediately Biglow turned his attention to a table which had been dipped up. The glossy mahogany showed an excellent set of finger prints. *The thief might just as well have left his calling card.*

To make a long story short, his prints were photographed and matched with those of "Big Joe" Moran, a jail bird. Moran was caught and convicted on Biglow's finger print proof. The money was recovered and a $500.00 reward given to Biglow in addition to his fees—as pay for his two hours work.

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Learn at Home in Spare Time

No more fascinating work than this—and big rewards go to the EXPERT. Thousands of trained men are now needed. The Finger Print work of governments, corporations, police departments, detective agencies, banks, individuals, has created a new profession. Many experts earn $3,000.00 to $10,000.00 a year. And now you can easily learn the secrets of this new science in your spare time at home. Any man with a common school education can become a Finger Print Expert in a short time.

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Qualify at home in spare time for a big position as Signal Engineer. Get into this great new field of fascinating work where quick success, with promotion and a high salary await you. Railroads everywhere need men who understand Signal Engineering and electrical safety devices.

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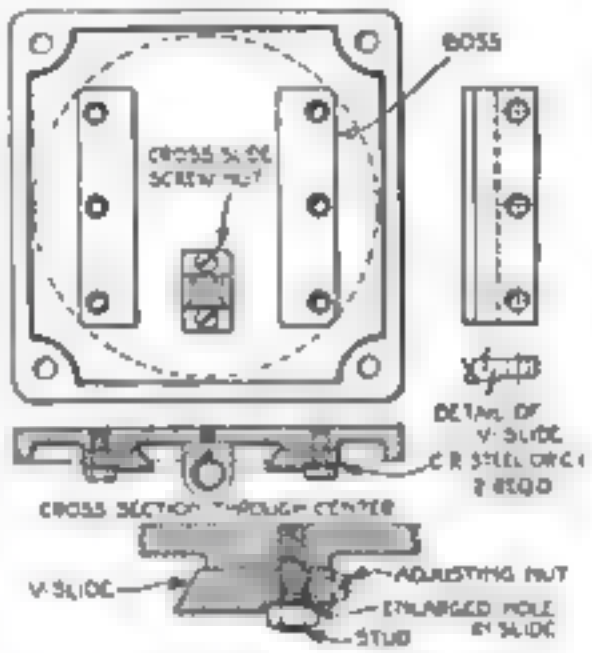
DEPARTMENT OF EDUCATION, Dept. 1369
1920 Sunnyside Ave., Chicago, Ill.

A Boring Table for the Small Lathe

A BORING or milling table is a useful accessory to the small lathe and the illustrations show how one may be made and fitted to the lathe cross-slide, using the original cross-feed screw. No planer or shaper work is required as all work is performed either in the lathe itself or on the bench.

The device consists of a cast iron table, either with a plain top or with slots cast in place, as the builder desires. The cross side of the table has a ledge around it to add strength and two lower bosses to which the V slides are bolted. Corner bosses, with holes through them, are shown, these, in the original apparatus, were intended to take a ½-horsepower motor with a grinding-wheel, bolted to the table for special grinding work; but the holes would also accommodate clamp bolts for large work.



Owners of small lathes will find this boring and milling table very useful in their work

A pattern for this table is easily made, as there are no cores or loose pieces. If the builder does not wish to use a casting, the table could be made of a piece of heavy iron plate. As the position of the feed-screw nut, if cast in place, would in all probability interfere with the machining of the bosses, this is made separately, tapped or threaded and screwed to the bottom of the table. Two V slides are made, either of cast iron or from cold-rolled steel stock; if the latter, the V slides must be filed or sawed to shape. Cast-iron V slides will have to be file-finished on the surfaces that bear in the cross-slide V's. They could be bolted to the face-plate and faced off in the lathe or ground on a high-speed abrasive grinding-disk.

The table casting itself is drilled and tapped for four holes, in the corners or otherwise, and bolted to the lathe face-plate and faced as nearly as possible to a plane surface; it is then reversed and the two under bosses are faced off. Next, the V slides are bolted in place, one of them being made adjustable after the somewhat novel method shown. Steel studs are set into the table and the V slide is set up by nuts on the ends of the studs. The holes in the slide are larger in diameter than the studs or are filed lengthwise to allow of a small amount of take-up. Smaller holes are drilled in the outer edge of the slide and corresponding ones drilled and tapped through the studs to take fillister-head machine-screws. To adjust the slide, the lower nuts are slightly loosened and the machine screws turned in, which will draw the slide against the cross-slide V's. The nuts are then set up and the adjustment is complete.

If no slots are provided in the table-top for holding the work, holes may be drilled and tapped at convenient points for clamping the work. The boring-table is quickly applied by drawing off the regular tool-slide and pushing the other on, using the same feed screw. Besides holding work for boring or milling and drilling, the table can be used, as stated above, for holding a small grinding-wheel motor for cylindrical or face grinding of work held between centers, on the face-plate, or on special brackets attached to the lathe-bed.—H. H. PARKER

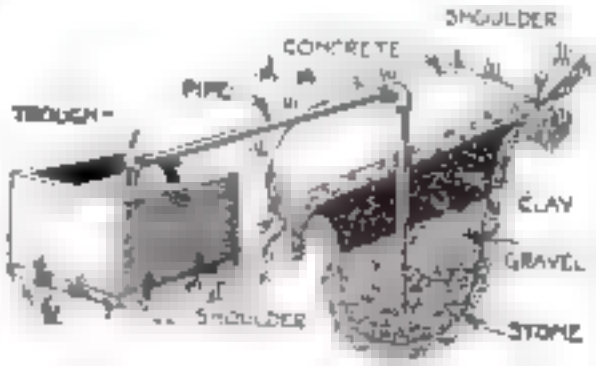
Piping the Flow of a Spring

VERY often when a spring is located in a low place and used for stock drinking-places, the trampling of the stock will break in the sides of the spring and cause it to fill up and get swampy. It is possible to pipe a spring of this sort so that the water may be carried to a distant point and allowed to run into a stock trough.

First it is necessary to dig out the spring location to good size and without making the depth any greater than necessary, but trying to arrange the spring so that it will have good solid sides or walls.

Take a short length of pipe, about 1 in. in diameter, and set it upright in the center of the spring and at a short distance from the bottom, being careful to keep the water baled out as it enters. Fill around the bottom of the pipe with good sized clean stone and then over that with fine sand and gravel to within a few inches of the top of the basin. The work must be done quickly. Then pack over the top with thick clay that has been previously prepared, and ram and tamp down firmly all over the top of the spring location. This makes a top coating that will not allow the rising water to seep through and later it can be covered with a layer of concrete to prevent rains from washing away the surface. The rising water can find an exit only through the pipe. Some experimenting may be necessary to find the correct height of pipe.

An elbow screwed to the upper end of the pipe and a length of drainpipe screwed into the elbow is used to carry the water to the trough placed at a slightly lower level than the spring.—B. F. DASHIELL.



If you have a spring on your land, you may improve it by collecting and piping the water as shown

Larger Picture Puzzles Free

How Many Objects Beginning with "C" Can You Find in Picture?

HERE is an opportunity for you [illegible] **Present for yourself.** It is not a fanciful dream but a straight cash and our opportunity for you to win $1,500.00. In the picture here you will find a number of objects and parts of objects whose names begin with the letter "C." Pick out objects like cat, cane, chest, etc. Nothing to buy. You do not even need to turn the picture upside down.

Everybody Join In

It Costs Nothing to Try

Sit down right now and see how many "C" [illegible] you can find. The object in this picture puzzle game is to get more people acquainted with Minnesota Fountain Pens. Thousands of them are now giving satisfactory service every day. We want you to buy one of our pens for yourself and another one to use as a gift. A Minnesota Fountain Pen makes a lasting present. "Christmas presents" and it will solve the problem of "what shall I give for Xmas?"

Fun for All the Family

Start in now and see how many [illegible] All in your [illegible] from the old home down to the little youngsters. You'll have loads of fun and if your answer is the one [illegible] awarded the prize by the Judges you will win $1500.00. However by just playing a Minnesota Fountain Pen you will be eligible for the big cash prizes.

Observe These Rules

1. Any person who is not an employee or relative of any employee of the Minnesota Pen Co. may submit an answer. It costs nothing to try.

2. All answers must be mailed by December 31, 1921.

3. All answers should be written on one side of the paper only and [illegible] Write your full name and address in each case.

4. Only words found in the English dictionary will be accepted. [illegible] but where the plural is used the singular should be omitted, and vice versa.

5. Words of the same spelling can be used only once. [illegible] As a rule no [illegible] letters may be used in the same word.

6. The contest being the largest and [illegible] prize [illegible] will be awarded each by Bureau upon deciding the Winner.

7. [illegible] yourself in preserving the puzzle [illegible] will [illegible] in your household [illegible] more than one [illegible] where two or more have been working together.

8. In the event of tie the full amount of the prize will be paid each tying [illegible]

9. These well-known business men have [illegible] with the Minnesota Pen Co. will [illegible] the answers submitted [illegible] Photographs [illegible] are available. The [illegible] will be judges of this unique competition.

W. H. Reuter [illegible] Publisher Exchange Bank, St. Paul; J. F. Kunze, Principal Franklin Public School, St. Paul; A. W. Sherrill, Fire Marshal Bureau, St. Paul.

10. All answers will involve the most [illegible] questions of whether or not an order for a Minnesota Fountain Pen has been sent in.

11. The announcement of the prize winners and the answer list of words will be printed on the back of the [illegible] and mailed to each person purchasing a Minnesota Fountain Pen.

How to Win $1,500.00

The purchase of one of our $5 Minnesota Fountain Pens [illegible] the Grand Prize [illegible] the Special Christmas Offer [illegible] the Special Advertising Feature we are making this.

Special Christmas Offer

As a special Christmas offer we are offering the grand prize of [illegible] the Special Christmas Offer [illegible] Two Five Dollar Pens for $9.00 in all. Or if you would prefer three [illegible] Minnesota Pens at $5 we will also make a gift to you of $1,500.00 Prize. Answer the puzzle and send your order now.

State Style of Pen Wanted

The Minnesota Fountain Pen comes in two styles and sells [illegible] in Pens for $2.00 and $3.00 [illegible] ladies and gentlemen's pens. The [illegible] who are playing [illegible] the prizes [illegible] state whether you wish the medium or stub point.

Money-Back Guarantee

We guarantee Minnesota Fountain Pens to be perfect [illegible] if you are not satisfied with it [illegible] return it and we will exchange it or refund your money.

MINNESOTA PEN CO.

Dept. 715

Saint Paul Minnesota

MINNESOTA

"The Easy-Writing Fountain Pen"

You will find the Minnesota one of the finest pens you ever used. The ink flows smoothly and pen and holder be easy to write. These pens were [illegible] but money can buy, we could not afford to advertise them for [illegible] Thousands of them are now in use. Their popularity is increasing by leaps and bounds. If you need a good pen or if you would like to make a useful and handsome gift a Minnesota Pen is just what you have been looking for. The pen speaks for itself. We cannot tell you in words what five minutes' use of the Minnesota will tell you.

Satisfied Users Everywhere

In New York, in Chicago, in Boston, in St. Louis, in San Francisco, and in fact in almost every town and in many a farm, you will find the Minnesota Fountain Pen. The ink flow in the Minnesota is perfect. It does not blot or stain the fingers. Writing becomes a real pleasure when you use the Minnesota.

THE PRIZES

	If one pen is purchased	If one $5 pen is purchased	If $9.00 worth Pens are purchased
1st Prize	$20.00	$500.00	$1,500.00
2nd Prize	10.00	250.00	750.00
3rd Prize	5.00	125.00	375.00
4th Prize	3.00	75.00	225.00
5th Prize	2.00	50.00	150.00
6th Prize	1.00	25.00	75.00
7th Prize	1.00	20.00	60.00
8th Prize	1.00	15.00	45.00
9th Prize	1.00	15.00	30.00
10th to 15th	1.00	10.00	30.00

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How to Make and Furnish a Doll's House

By E. Bade

Make the framework of the doll's house from parts of an old box, and saw doors and windows to suit

EVERY boy who has a younger sister can make for her a doll's house from an old box and some odds and ends of wallpaper. Any [illegible] about [illegible] long, 1 ft. [illegible], and 1 ft. high [illegible] be used. One side [illegible] cut out and all projecting [illegible] removed.

Three [illegible] which form windows, are cut out from the back of the box, and a partition, with a large rectangle sawed out to represent a door, is nailed to the box, which now consists of two rooms—the dining-room and the bedroom. A door is

An open fireplace lined with brick-paper may be made and provided with a mantelshelf

made that must fit into the rectangular opening. This is later nailed to the partition with two small brass hinges so that it can be opened. Cornices are nailed around the top of the box. This gives the finished house a realistic appearance.

Brick or wood paper is glued to the outside of the sides and the back of the box, while the inside is finished with odd pieces of wallpaper. The windows are fitted with glass and small strips of wood represent the sills.

The furniture for this doll's house may be made of cigar-box wood. The tools required consist of a knife, a hammer and some small nails. Paint or stain can also be used, although this is not absolutely necessary.

Chairs, beds, and benches are made from strips of cigar-box wood. These should be

Brick-paper is pasted on the outside of the house and the windows are provided with frames

about ⅝ in. wide, and as thick as the wood. It is best to cut the wood with the grain. This will make the strips as long as the box. They are cut into suitable lengths for the legs, sides, and seats of the different pieces of furniture.

To make a chair, cut two 8½-in. pieces for the back legs, and six 1¼-in. strips for the seat and the braces and two other 1¼-in. pieces for the back rest. Arm-

With a little patience a complete set of furniture for the doll's house may be made of cigar-box wood

chairs, Morris chairs, and rocking-chairs are similarly made. The same method is employed when making the bedroom furniture.

A dining-room table is made from an empty spool, preferably a large one, upon which a 3-in. square of cigar-box wood is nailed. If the table should not be high enough, two or three thicknesses of wood can be nailed under the spool. These will represent the feet of the table.

An open fireplace can also be made of a small box about 3 in. square with one side removed. Slanting sides are nailed to the

The arrangement of the interior and the addition of ornaments may be left to the taste of the owner

box to represent the chimney. About ¼ in. above the box, one of the strips made for the furniture is nailed around it. This will give the appearance of a mantel. To heighten the effect brick-paper is glued to the wood.

"Every-Day Wonders"

Beginning with this issue, POPULAR SCIENCE MONTHLY will publish each month ten questions on general science that affect your daily life. To know and understand the answers means that you have laid the foundation for a sound education. The questions will be found in this number on page 32. The answers are printed on the same page.

Wood Puzzles that Will Interest Your Friends

FIGURE 1 shows a piece of wood with a round, a square, and a triangular hole in it. The puzzle is to cut one piece of wood that will exactly fit the three holes.

To do this, get a cylindrical piece of wood that will exactly fit the round hole in Fig 2. From this cylindrical stick cut off a length equal to its diameter. If put in sideways, it will fit the square hole. Now draw a line through the center of the circle across one end and from the circumference

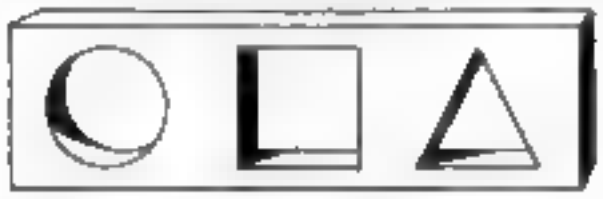


FIG. 2. FIG. 1.

The peg to the left will fit a round, a square, and a triangular hole

of the other end cut a bevel to this line. The plug will then fit each hole.

Figure 3 is the mysterious dovetail. It seems impossible to make, as the mortises apparently run through each other from each side. Figure 4 shows how it is made. Join two square-cornered pieces of wood neatly and carefully by two mortises. Then chisel the corners off to the dotted line, leaving another square block as shown in Fig 3.

Figure 5 is one piece of wood passed through another, which just fits the stem,

FIG. 3.

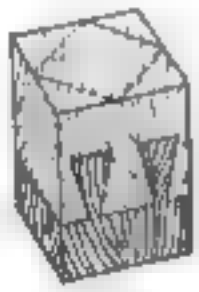


FIG. 4.

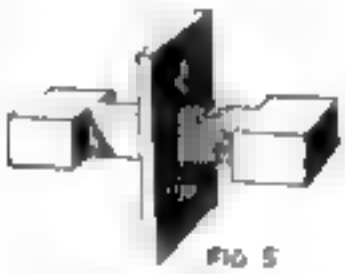


FIG. 5

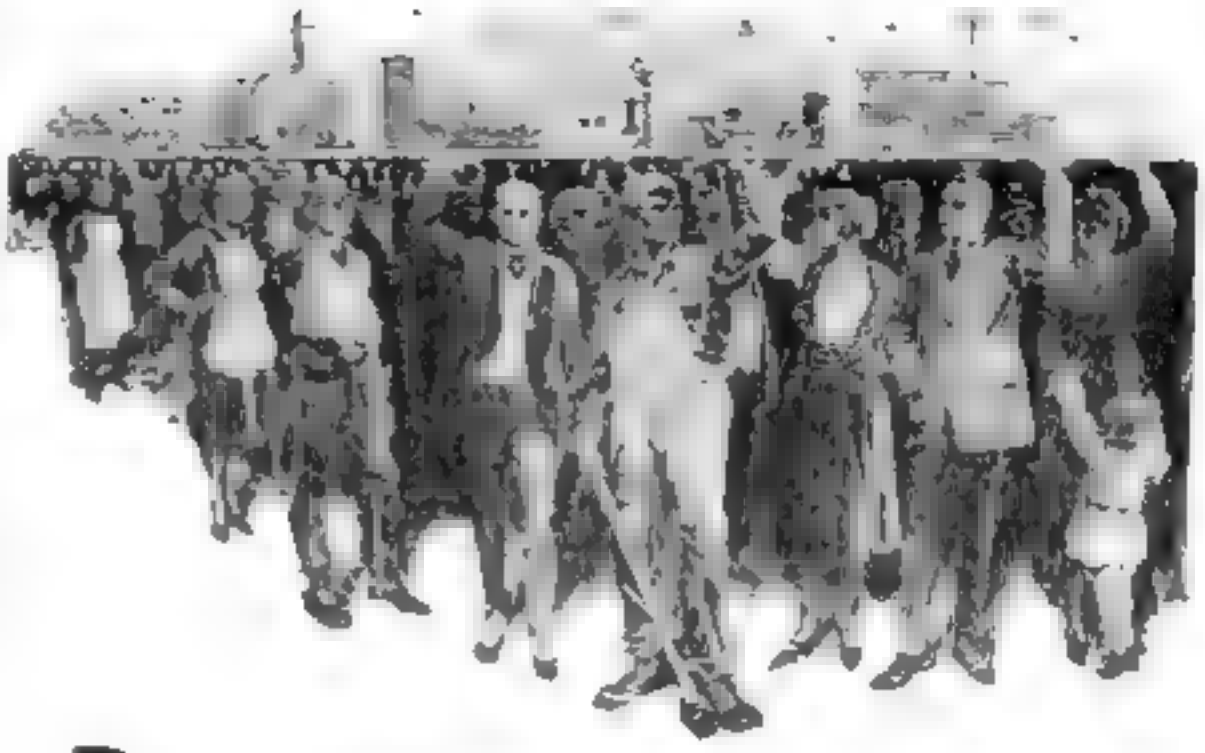
FIG. 6

The construction of two puzzles that can be cut from a block of wood

or narrow part, and has no joint. It may be made either by choosing soft wood and soaking it in boiling water until compressible, or, better, by making two pieces like Fig 6, and gluing them together. The joints, being at the corners, should be quite invisible. E. A. McCann

Do You Know How to Make a Glue-Joint Invisible

WHEN making a glue joint, always, if possible, lightly sandpaper the joint before the glue dries. This will fill up any slight crack with fine sawdust and greatly aid in hiding the joint.—E. A. McCann.



Democracy

"—of the people, by the people, for the people"

People of every walk of life, in every state in the Union, are represented in the ownership of the Bell Telephone System. People from every class of telephone users, members of every trade, profession and business, as well as thousands of trust funds, are partners in this greatest investment democracy which is made up of the more than 175,000 stockholders of the American Telephone and Telegraph Company.

If this great body of people clasped hands they would form a line more than 150 miles long. Marching by your door, it would take more than 48 hours of ceaseless tramping for the line to pass.

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There is one Bell telephone shareholder for every 34 telephone subscribers. No other great industry has so democratic a distribution of its shares, no other industry is so completely owned by the people it serves. In the truest sense, the Bell System is an organization "of the people, by the people, for the people."

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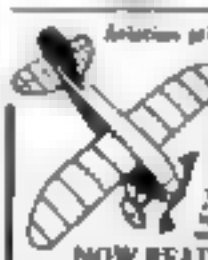

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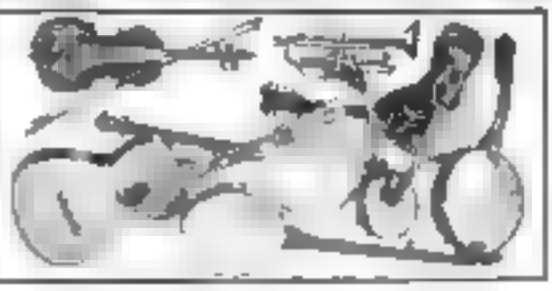

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The Letter That Saved Bob Johnson's Job

—and paved the way to a better one!

IT was written to his employer by the International Correspondence Schools. It told how "Robert Johnson had enrolled for a course of home-study and had received a mark of 94 for his first lesson."

Bob answered the summons to the Chief's office with just a little fear and trembling, for a lot of men were being dropped—a lot more were having their pay reduced.

But as Bob came in, his employer did a surprising thing. He got up quickly from his desk and grasped Bob warmly by the hand.

"I want to congratulate you, young man, on the marks you are making with the I. C. S. I am glad to see that you are training yourself not only for your present job but for the job ahead.

"We're cutting the pay-roll. Until I received this letter, I had you in mind as one of the men to be dropped. But not now. Keep on studying—keep your eyes open—and pretty soon there'll be a better job for you around here. We're always looking for trained men."

Won't you let the I. C. S. help you, too? Won't you trade a few hours of your spare time for a good job, a good salary and the comforts that go with it? Then mark the work you like best on the coupon below and mail it to Scranton today. That doesn't obligate you in the least, but it will be your first big step towards success. *Do it now!*

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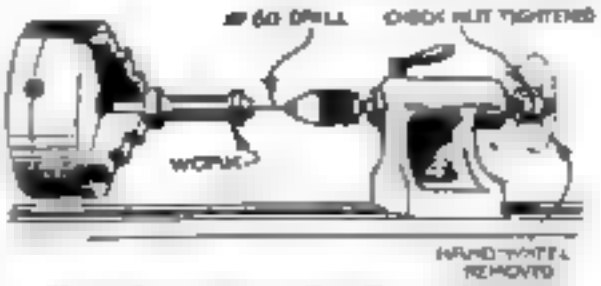
THE HOME WORKSHOP

To Prevent Breaking a Small Drill

By Albert Strandin

First Prize, "Best Idea" Contest, December



Your fingertips will tell you how to feed the drill without breaking it

TO drill a hole with a small drill in a piece that is chucked in an engine lathe, without breaking the drill requires great skill and patience. The least bit of excessive pressure applied to the hand wheel will result in a broken drill and many times in a spoiled job.

To eliminate this trouble, the writer evolved a simple scheme that works very satisfactorily.

By removing the hand wheel on the tailstock shaft and tightening the nuts in place, as shown in the picture, the worker, by the use of the thumb and forefinger, can obtain a very sensitive touch for feeding the drill, which otherwise would not be possible.

This Boiler-Baker Is a Boon to Housewives

By Roland B. Cutler

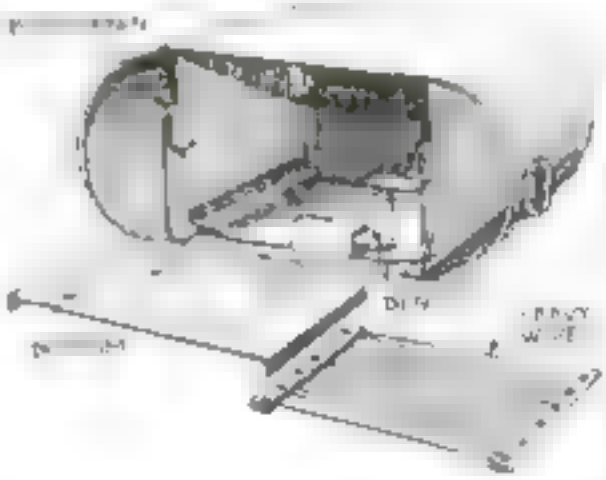
Second Prize, "Best Idea" Contest, December

AN excellent oven for the oil- or gas-stove can be made from an old wash-boiler and a length of stove-pipe, heavy tin, or galvanized iron.

Centered on one side of the boiler, mark out a 9 in. by 12 in. space; the 9-in. width beginning about 2 in. from the top and bottom if the utensil is standard. In the center of this space cut out triangle flaps each 4 in. wide, and bend them up 2 in. and over at right angles to form supports for the oven bottom. Cut each side flap far enough so that when it is bent back and up 2 in., the supports will be about where the curve commences, as shown. This cut-back will probably be 4 in.

Cut the bottom 10 in. wide and with the ends bent over 1 in. to fit over the supports. Cut each side to fit in the boiler with one end bent 1 in. at right angles. Slit each corner of the top far enough to bend down and out 1 in. midway of the oven on which a second bottom or shelf can rest.

Make this out of heavy wire doubled back and forth to the right width, and fasten at the ends with lengths of tin 2 in. wide, doubled over and rivated between the wires as shown. Punch a ¼-in. hole in each end of the boiler, 2 in. above the oven-bottom level for ventilation.



The handy man may construct this baking-oven from an old wash-boiler

$75 in Prizes Each Month for the Best New Ideas

A FIRST prize of $50 and a second prize of $25 will be awarded every month to the authors of the two best articles appearing in this department. Every article submitted will be considered as a possible prize-winner. Those which do not win prizes may be purchased at space rates. The prizes will be awarded upon publication and checks will be mailed to the winners during the same month.

Prize-winning articles may be long—but not over 1000 words—or they may be very short. The idea, device, or machine described must be practical and ingenious; it must fill an actual need in the home, office, or shop.

This contest must not be confused with other contests which Popular Science Monthly is conducting at this time.

Prize-Winners for December

The two prizes of $50 and $25 for the "Best Ideas" appearing in the December issue of Popular Science Monthly have been awarded respectively to **Albert Strandin**, Chicago, Ill., and **Roland B. Cutler**, Springfield, Vt. These two ideas were considered by the judges to possess the highest all-round merit.

It should be remembered that this "Best Idea" contest is a monthly feature. You may have an idea that will win the prize next month. Read the rules above.

THE HOME WORKSHOP

Improved Spur for Stump-Boring Auger

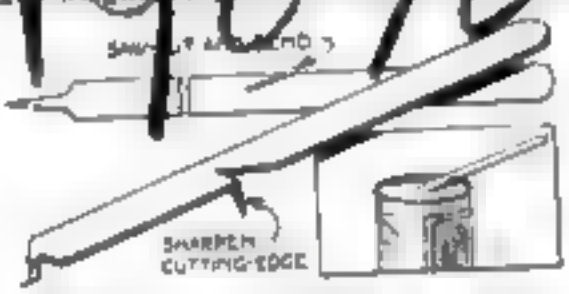
This method of changing the spur of the auger makes it efficient

BECAUSE of the fact that when one is boring a hole in a stump preparatory to blasting, one cannot tell when [illegible] at the point of the auger will leave the solid wood and get into soil, so losing its feeding power it is well to use an auger having the side cutting spurs at right angles to the cutting lips. Such an edge will allow of cutting down into the roots.

When a rounded spur auger [illegible] the rounded form [illegible] the spur will [illegible] force the auger out of the wood, while it is almost impossible to cut well [illegible]. If you take a file and cut the spur to the shape shown, the edge, being at right angles to the line of cut, will cover all wood and roots with ease.

Can-Opener Easily Made from Strap Iron

CAN-OPENERS can be made in any desired size by using a [illegible] piece of light-weight strap iron or steel as shown in the drawing. One end is pointed and a cut is made in the piece at an angle. The end and the cut are bent as shown. The cutting edge must be sharpened.



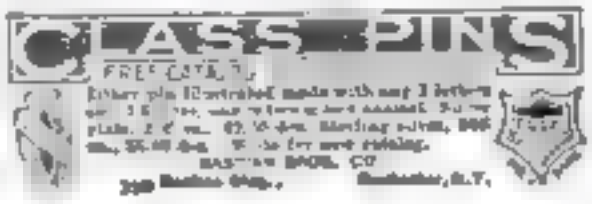
This can-opener, made from a piece of strap steel, will be found effective for cans of one size

Here Is a Use for a Discarded Gasoline Barrel

WITH a little work, a gasoline barrel may be turned into a useful waste-burner.

The top of the tank should be removed with a hatchet or tin shears. A small door should also be cut in the side of the tank next to the bottom, to be used as a draft door. Then a stand made of strong strap iron, which is easily procured, should be placed in the bottom of the tank. A wire screen resting on this stand will serve as a grate. When waste is ignited in the tank, it will burn rapidly and with safety from sparks.

A waste-burner for the back yard



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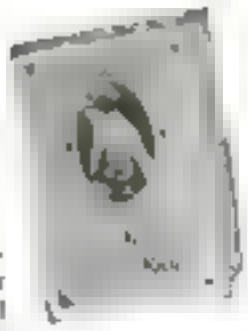

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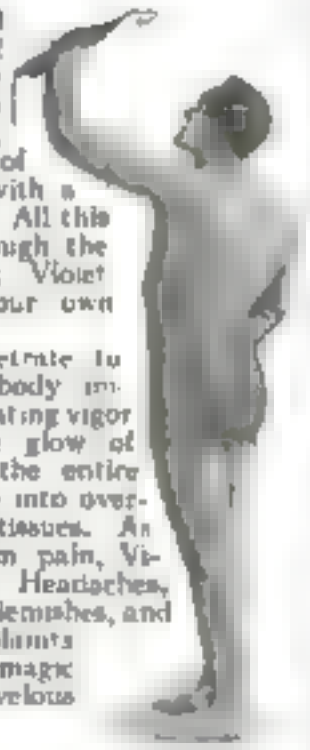

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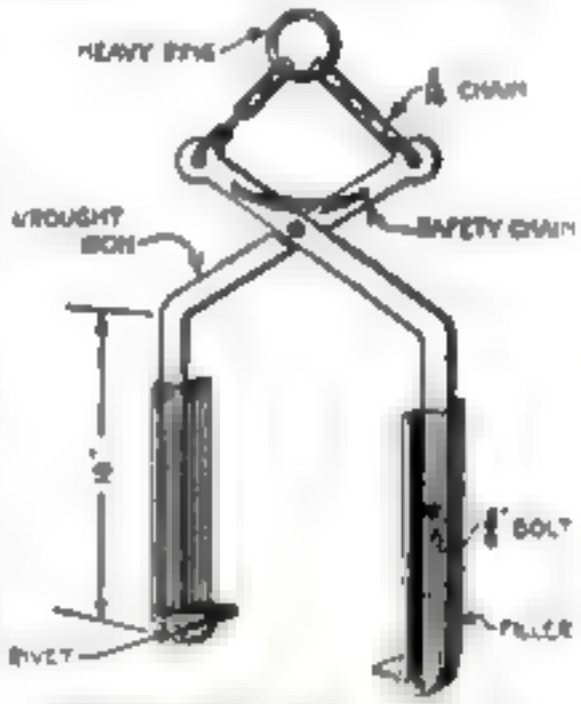
To Lift Locomotive Driving Boxes Vertically

THE width of the device shown here can be made as desired, to suit the size of the box or of a size that will average reasonably close for boxes close to the range of the lifter.

The tong part is made of ⅜ in. by 2 in. iron, while the lifting hooks are of ⅜ in. by 1½ in. by 2½ in. angle-iron. The tongs extend down only to about the middle of the lifting pieces. These are fastened to the tongs by ½-in. bolts on which the lifter can swing. Below the tong part a ⅜-in. filler is provided, which is riveted to the angles.

A ⅝-in. bolt is provided as a pinion for the tongs. Fastened or linked on to the lifting-ring, 5/16-in. chains are used. You will note the action, that in lifting, the pull on the chains transmitted to the tongs tends to close them on the box.

Another very good feature is the safety chain, which is fastened by an eyebolt at one end and goes over a hook at the other. Hence, when the device is placed on a driving-box, an accident through the opening of the device is almost impossible.



Lifting-tongs of this type are very useful in shops where heavy loads of square forms must be lifted

This device is well-nigh indispensable for placing driving-boxes on axles of locomotives and can also be used in lifting off boxes to be repaired.—L. J. BITNER.

Wheelbarrow Wheels Can Be Built at Home

I MADE a fairly good wheel in the following manner: Two circular disks were sawn from a 1 in. by 14 in. plank, the full width of the board. A ⅝-in. hole was then bored in each and the two pieces were nailed together, crossing the grain of the wood, and using sixpenny finishing nails. Nails were driven into the disks about 1½ in. apart from each side and the nails were clinched. Two 1 in. by 6 in. blocks, with the corners sawed off and each block chamfered on one side and ⅝-in. holes bored through their centers, were then nailed to the wheel—one on each side—with the grain of the blocks crossing the grain of the piece to which it was nailed. These pieces also were shower nailed.

A ⅝ by 3½ in. common pipe-nipple and 7/16 by 10 in. bolt and nut and four ½-in. cut washers completed the axle assembly.

The ⅝-in. nipple was driven into the hole in the center of the wheel, about ¼ in. protruding on each side. The frame of the barrow was made so as to allow for a washer at each end of the nipple, or hub, of the wheel, and a washer under the head of the bolt and under the nut.

In giving the length of the pipe-nipple for the hub, or thimble, and the length of the bolt which is to be used for the axle, it must be remembered that these lengths are for dressed lumber, which is only 13/16 in. thick; thus the four pieces when assembled will measure 3¼ in. However, if necessary to use undressed lumber, be sure that both the nipple and the bolt are long enough. Remember also, that pipe-nipples are measured *inside*, and further, they are all oversize; hence you cannot use a ½-in. bolt for the axle—the wheel would wobble too much. There is little likelihood of the nipple ever coming loose if it is driven tightly into the wheel.

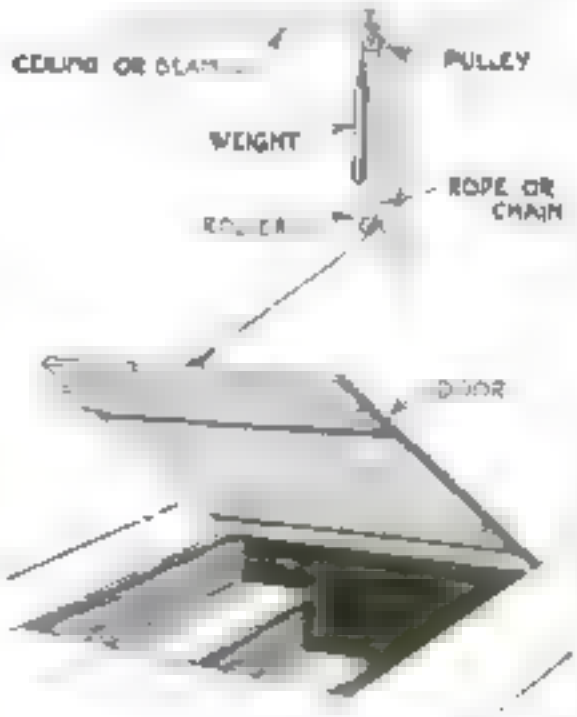
This wheel can easily be made by the amateur carpenter

A wheel made in this manner will not only have very little wobble, but it will last for years; and it is inexpensive.

A Weight to Aid in Lifting Heavy Doors

A RESTAURANT I visit has a large icebox with heavy lift door. It is necessary for the waiters to raise this door many times.

The ingenious proprietor placed a strong window-weight cord with weight attached over a pulley in the ceiling above the box, then attached the other end of the cord to the front of the icebox door. The weight is not quite so heavy as the door, but it helps materially, and the appliance is so arranged that the door stays open in a vertical position after being raised, allowing the waiter to use both hands in removing things from the chest.—A. W. ROE.

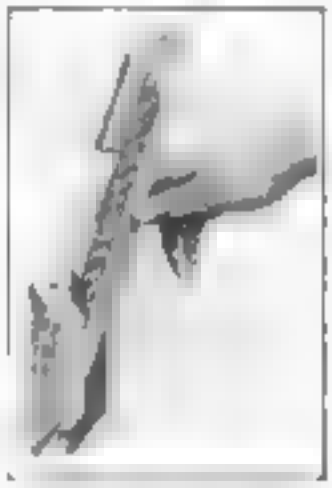


Provide your cellar trapdoor with a counterweight and you will be able to raise it much easier

THE HOME WORKSHOP

Shoe-Polishing Rendered Easy with a Support

DON'T polish your shoes on a chair or other furniture. Make a shoe-polishing stand. It takes up no room, does not disfigure the wall, is very useful, and is easy to make.



When not in use, the foot-rest folds against the wall

All that is necessary for such a device are a few pieces of wood, a bolt, and a number of screws of different sizes, a saw, a plane, and a screwdriver.

First, two pieces of wood are cut alike, and planed down. These are the supports of the footrest. These two pieces should be made of stout material so that they will not break by the strain to which they are subjected. The crosspiece holding the foot-rest should also be made from a stout piece of wood, and must be tapered. The end projecting outward from between the two supports can be made as thin as desired, although it should be at least ½ in. in thickness. The other end, especially that part which lies between the supports, should be quite wide. When this piece has been cut, the footrest, which may consist of a thinner piece of wood, should be attached to the crosspiece.

The rest is turned down when required for polishing shoes

The bolt is passed through the two supports and through the cross piece. Then the supports can be attached to the wall at any convenient place about 1 ft. above the floor. When the stand is to be used, it is simply let down so that it stands horizontally. When out of use, it is lifted and rests flush with the wall.

If Your Pipe Fails to Draw, Try This

BEFORE loading the pipe with tobacco, place a small piece of steel wool in the bottom of the bowl, and press it down with the finger. Then the tobacco may be filled in. By doing this, you not only get an easier draft in your pipe, but it prevents the pipe from becoming clogged with small bits of tobacco. The steel wool also stops the nicotine from going through the pipe and may be changed whenever necessary.

STEEL WOOL

Steel wool in the bowl keeps the tobacco out of the stem

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3 Hanes Elastic Crotch are made far stronger and better than the usual cuff. They fit the wrist firmly, they don't flare and won't rip from the crotch.
4 Hanes 2-Button Hanes Waistband supply real comfort in the drawers. Made of sturdy cotton—double power! long wear is sure.
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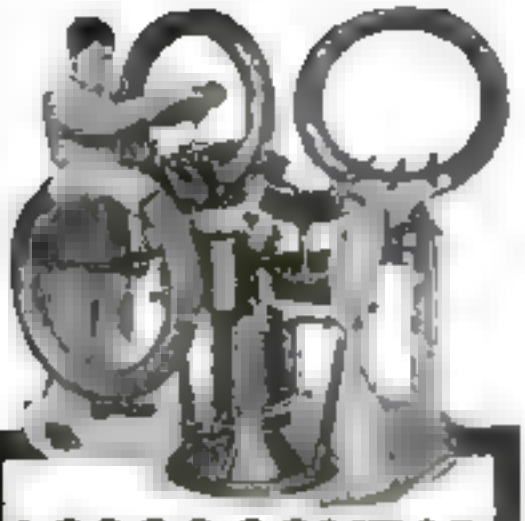

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Above successes were made within past eighteen months. These men took advantage of splendid opportunities. Keep your own [illegible] are condemning. Not buying new tires. Making old ones do. There are 6,000 Haywood Fire Surgery stations which cash business.

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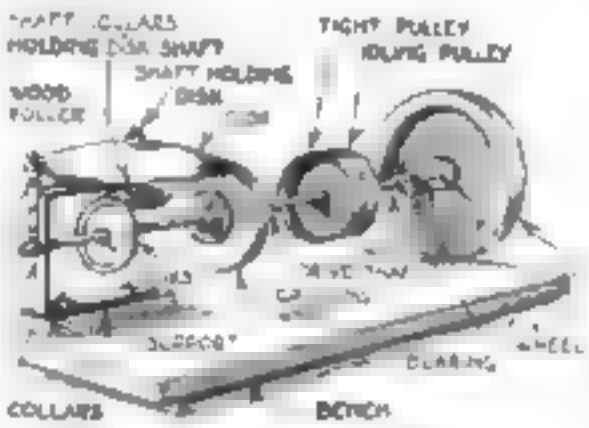
You Can Make this Disk-Grinder Yourself

By L. M. Jordan

OUTLINED in the illustration is a disk-grinder that is simple in construction and operation and grinds the disks automatically.

Procure a piece of 1-in. shafting, 6 ft. long. This shaft is mounted in a box bearing near one end on a mounting attached to a bench as shown, and the other end passes through a 1-in. hole in the center of a piece of malleable iron 1 in. thick, 3 in. wide, and 2¼ ft. long, bent into the shape of the letter U. This iron lies on a block mounting on the bench, which is lower than that supporting the box bearing at the opposite end.

The lower side of this U-shaped stud is fastened to the block support and the bench with two heavy bolts drawn tightly. Through another hole in this stud extends a short piece of the same size shafting 10 in.



With a little skill and few tools you can make an automatic disk-grinder

long, 2 in. of the upper end of which are threaded for a retention nut. This short shaft is held at the proper height by two shaft collars. On the lower end of this shaft is mounted an 8-in. gear in an inverted position, beveled for right-angle driving. This gear is engaged by a similar 6-in. gear mounted on the drive-shaft as shown.

A small wooden roller is mounted on the U-shaped stud in brackets made of strap-iron and riveted to the stud. This roller holds up one side of the disk level and the opposite side rests on the top face of a 3-in. emery-wheel mounted on the drive-shaft under the disk as shown. An inch of the short vertical shaft immediately under the threads is squared square to fit the square hole in the disks. The disks are put on this shaft in an inverted position and a nut is screwed on to prevent them from coming off the shaft during the grinding.

The drive-shaft is prevented from playing back and forth in its bearings by two shaft collars, one on either side of the disk support piece or U-shaped stud. The hole in which the shaft rests in this piece is its bearing at this end, and should be kept well oiled.

Near the box-bearing mounting two small pulleys are mounted on the drive-shaft. One idles on the shaft and the other is fastened and drives it, with a small belt from the engine or countershaft. This allows shifting of the belt from driving pulley to idler when necessary to change disks.

A flywheel is mounted on the end of the shaft to balance the motion and power of the grinder. The disk rotates at lesser speed than the emery-wheel and in an opposite direction. A small wooden roller supports one side of the disk, while its other side rests on the face of the emery-wheel. On account of the ratio of the driving-gears the disk does not rotate as fast as the grinder, yet fast enough to keep it cool and grind it evenly and uniformly. Many disks can be sharpened in a day with this apparatus.

A Capacious Fountain for the Poultry

A POULTRY fountain that will hold enough water for a large flock may be made from a square 5-gal. oilcan such as is used for automobile oil and of which the spout and the screw-cap are melted off.

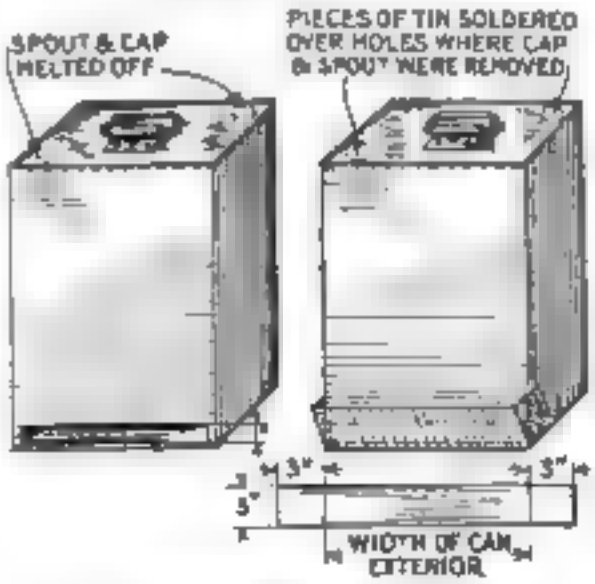
A strip 2 in. wide and the full width of one side of the can is cut, and the can cleaned inside by scalding it with lye or washing it with gasoline. This strip is cut ¼ in. from the edge or bottom of the can to leave a surface to which to solder. This surface is cleaned and scraped or sandpapered, so solder will adhere. A strip of tin 2 in. wide is now cut 6 in. longer than the exterior width of the can and the ends are bent so it will just straddle the can.

Clean this strip along one edge on both sides of the piece and both ends likewise so the solder will stick. Now lay the strip over the hole in the can with its clean edge along the bottom of the can and solder along the edge.

Then pull the top edge away from the can about 1½ in. and clean the sides of the can where the ends of the strip will be soldered and solder the ends watertight.

Cut out pieces of tin large enough to cover the holes where the spout and cap were attached to the top of the can, clean the pieces and the can and solder airtight. Lay the can on its side opposite this opening and pour in water until it is full, then set it up.

If raised from the ground by setting it on the inverted half of another can of like size, with small ventilating holes in it near the bottom, a brooder-lamp may be placed under it in cold weather. This will give the chickens warm water all winter.

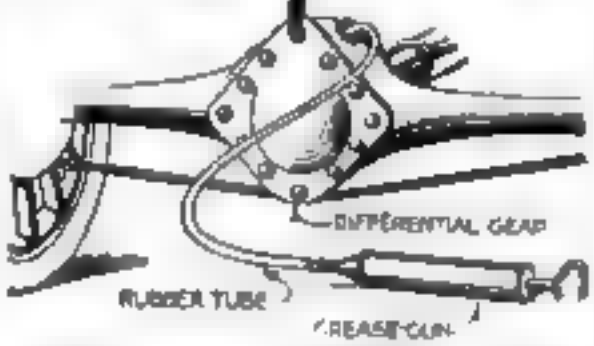


How a large square oilcan may be transformed into an automatic fountain for chickens

Try a Rubber Hose on the Grease-Gun

IT'S a messy and tiresome job at best to keep the differentials and transmission filled to the proper level with grease, and the job is often neglected for this reason.

If a piece of rubber tubing is attached to the grease-gun, it is unnecessary to crawl



Make your grease-gun more effective by adding a rubber tube

under the car to lubricate a transmission.

Procure about 5 ft. of ½-in. rubber tubing, obtainable at an automobile accessory shop, and wire it to the end of the grease-gun spout.—J. C. OTTOFY.

Transforming a Tea-Kettle into a Glue-Pot

OUT of an old kettle and a tin can, I have made the glue-pot illustrated and it has given satisfactory service.

An old water-kettle that I found in the a[illegible] for the [illegible] and [illegible] for the glue receptacle.

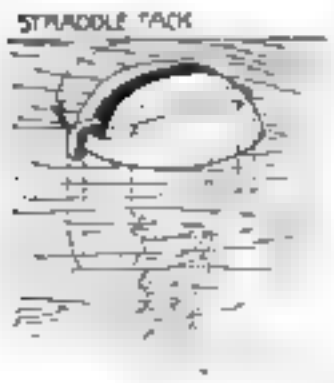
A ring about ¾ in. wide was cut from a piece of galvanized iron, and soldered to the outside of the can to keep it from resting on the bottom of the kettle and also to keep the kettle steamtight.

The water in the kettle prevents the glue from burning

How to Prevent a Wood-Screw from Loosening

WOOD-SCREWS will quite often loosen in any construction where there is continued vibration. These may be effectively locked in the method shown.

The screw is tightened down in the usual way. A straddle tack is placed over the head of the screw and driven down, the middle section of the tack fitting into the slot of the screw. If the tack is not wide enough to fit over the head of the screw, a small brad may be driven down beside the screwhead and bent over until it fits in the slot. Either way provides a simple method of keeping the screw from turning.—L. R. BUTCHER.



Slot-head screws may be locked as shown

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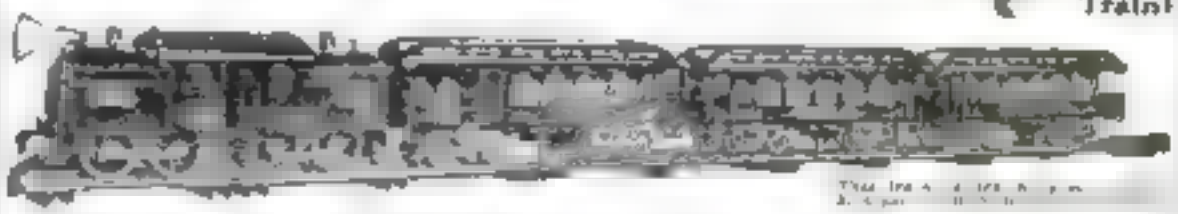

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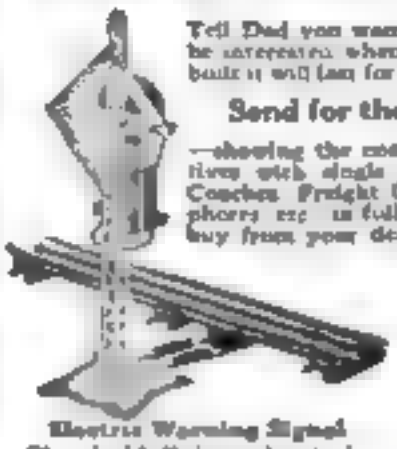

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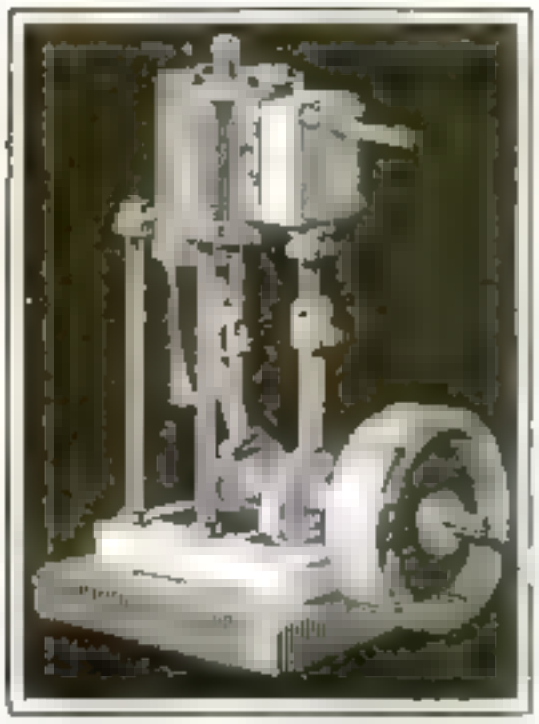

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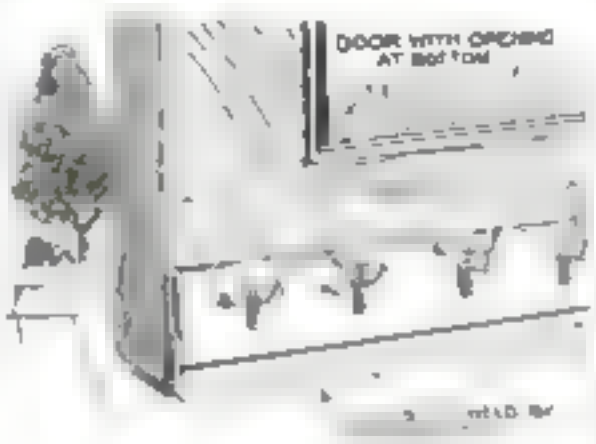
THE HOME WORKSHOP

This Weather Strip Will Adjust Itself

A WEATHER strip on the bottom of the front door must close the open space entirely to exclude the cold, but when the door is swung inwardly the weather strip will strike the carpet and prevent the opening of the door. The strip shown in this illustration corrects this common defect by having narrow slots instead of screw-holes.

When the strip strikes a high place it slides upward, and when the door is closed again the strip falls by its own weight and



Save coal by providing your outside door with one of these self-adjusting weather strips

makes a perfect closure. Round head screws are used and they are turned in just far enough to permit the up-and-down movement of the metal piece. An old [illegible] strip bent double at the top and with a piece of felt or rubber between the layers at the bottom is used. It makes a very neat and [illegible] weather-tight [illegible] and may be used for many years.

In the summer the strip is pushed up to its extreme height and held there by tightening on two of the outside screws. In the cold weather these screws are loosened and the strip again becomes a barrier to wintry blasts.

Indirect Light from an Old Wash-Basin

THE worker who finds need for indirect light in his workshop will find this a satisfactory way to secure it. First the ceiling is painted white, and the inside of an

Good light is necessary for doing good work and indirect lighting is superior to direct lighting

old metal wash-basin is also painted white. The basin is then suspended from the ceiling in the manner shown. The rays of light are first reflected to the ceiling and then distributed over the room.

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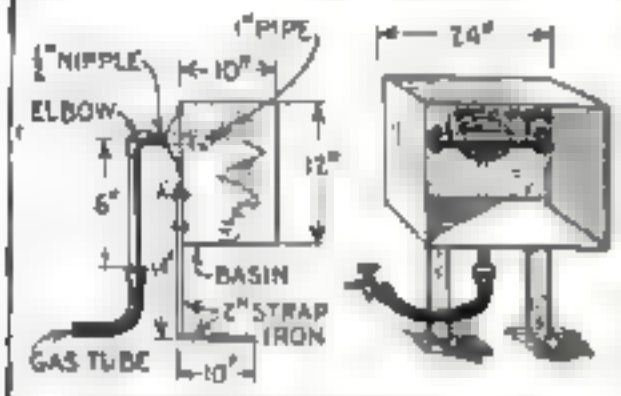
Old Sink Forms Foundation for Gas-Stove

FROM an old drain-basin with a 10-in piece of 1-in. pipe, a ½-in. nipple of ½-in. pipe, ½-in. elbow, 6 in. of ½-in. pipe, and 2 plugs, I made a very serviceable stove. The legs were made of two pieces of old strap iron 2 in. wide and 24 in. long, bolted with two ¼-in. stove-bolts to the back of the basin. They were bent in an L-shape, one leg 10 in. and the other 14 in. long. In each leg two ¼-in. holes were drilled.

The bottom of the basin had a 1-in. hole in it. This was covered with another piece of tin, an old pot-cover hammered into a



This simple type of gas-stove may be made from an old drain-basin

cup shape, in which a ½-in. hole was drilled for the ½-in. nipple that was connected with the 1-in. pipe. This 1-in. pipe was tapped in the center for the ½-in. nipple. The ends were capped. On the opposite side from the ½-in. tapped hole 1/32-in. holes were drilled ⅛ in. apart; these were the burner holes. To assemble the caps were screwed on to the 1-in. pipe, then the nipple was tightened into the 1-in. pipe; this was put inside of the basin. The nipple was just long enough to reach through the cup shape of tin.

When the elbow was tightened it held the burner in place. The 6-in. pipe connected the stove by a tube with the gas-plug. I used this stove all winter with success.—L. K. LANIER.

Homemade Cook-Book Holder for the Housewife

HERE is a convenient device for the kitchen that is easily made. It [illegible] in any size desired.

A piece of tin is bent [illegible] a small piece of wood, just [illegible] to

Your wife will appreciate this device for holding the cook-book

support the edge of the cookbook at the bottom. Two nails driven through the tin at opposite ends hold it securely. A wire bent as shown and secured in the ends of the wood will hold the book open at any page desired.—K. H. HUNTING.

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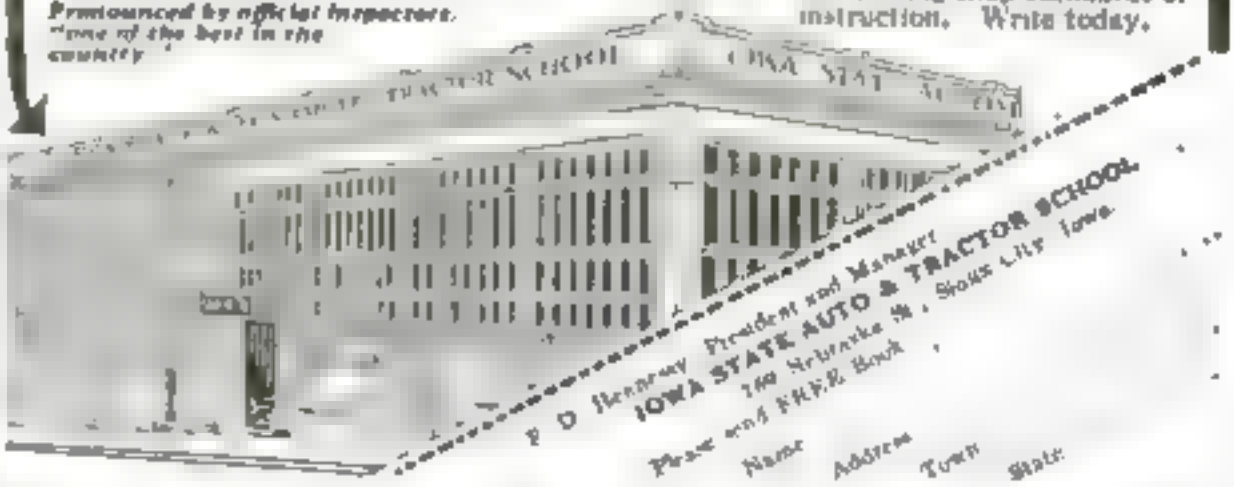

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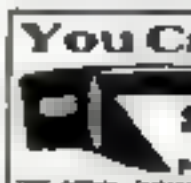

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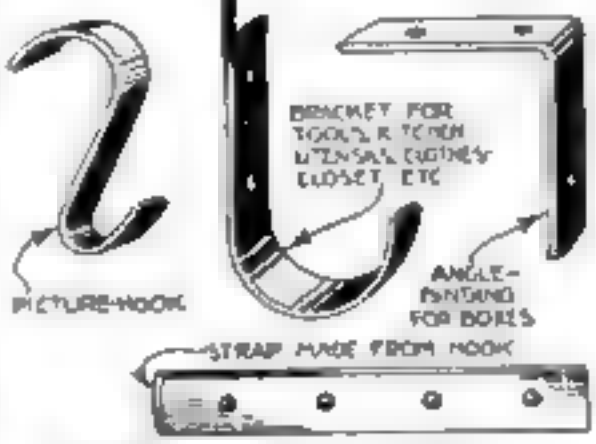
THE HOME WORKSHOP

Some Uses for Picture-Hooks for Hanging Pictures

COMMON brass picture-hooks can be put to a variety of uses for which, ordinarily, special strips must be cut.

If they are hammered out flat and then punched for round headed screws they make fine ornamental strips for putting on homemade furniture.

They can be flattened and bent at right angles and used as angle bindings for boxes or cabinets.



Picture hooks may be bent in various ways to adapt them to other uses

They may also be partially straightened out and used as brackets for supporting such tools as braces, hand drills, drawing knives, etc.

In the kitchen, when screwed to the wall, they make excellent supports on which to hang kettles, dishpans, or other utensils.

If tacked around the walls of closets, articles of clothing may be hung upon them. Other uses will naturally suggest themselves.—L. H. Kirby

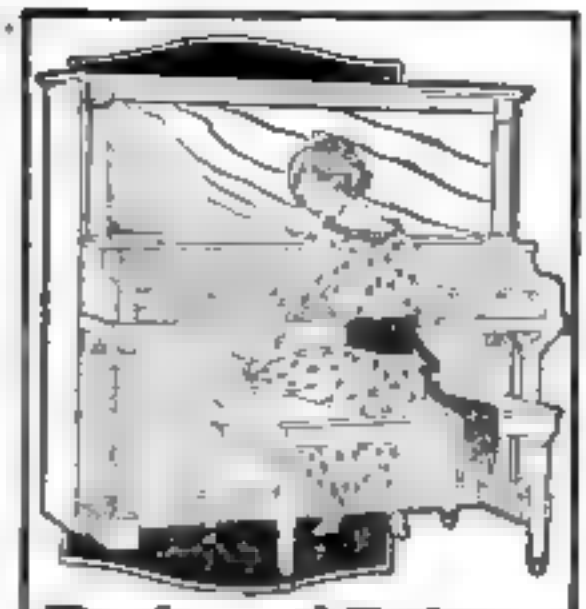
Shutter-Frames Can Be Used for Window-Screens

NEEDING some screens for the windows I brought from the cellar some old shutters.

Selecting those that fitted the windows I wished to screen I removed the hinges by sawing them on one end. They then dropped out, leaving a good strong frame.

Practical window-screens may be made from old shutter-frames

Over these frames I tacked screen wire. After painting them, I put them on the windows. The hinges and catches were still in place. The screens were very satisfactory, as they could be thrown open, allowing one to shake dusters, etc.—Mrs. H. E. Hold.



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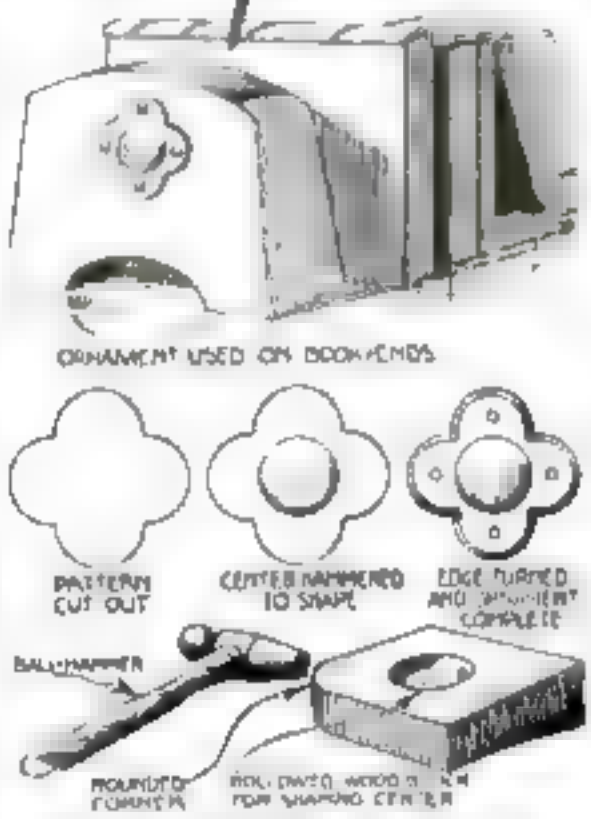
THE HOME WORKSHOP

Ornaments of Hammered Brass Are Welcome Gifts

ORNAMENTS of hammered brass are very effective for decorating book-ends, desk sets, pipe-racks, etc., and the only tools required for making them are an old pair of scissors, a round-headed hammer, a gouge and some blocks of hard wood.

Draw some circles and ovals on the end grain of the wooden blocks and with the gouge work them out into smooth depressions of any desired depth. Make a



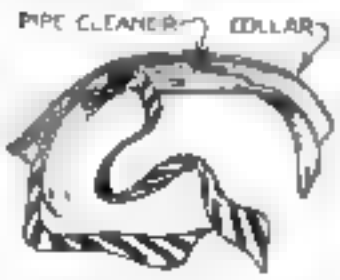
Handsome ornaments of hammered brass may be made with simple tools

pattern of the proposed ornament on paper; cut this out, lay it flat on some sheet brass 1/32 in. thick, and mark around it with a lead-pencil. The brass is then cut out with the scissors.

Suppose you use the quatrefoil design illustrated. First place it carefully centered over a circular depression in the block and beat it gently with the head of the hammer until the brass bulges and fills the hollow. Next hold the brass with the bulge upward so that the edge projects over a rounded corner of the wood and tap it so as to bend the rim. Keep turning until the entire edge is rounded over. Then punch the brad- or screw holes and the ornament is complete. Polish with fine sandpaper or emery.—L. H. KIRBY

How to Improvise a Slide-Easy Collar

UNWIELDY starched collars are quickly converted into slide-easy ones by putting a pipe-cleaner well up into the center of them as shown in the illustration. The tiny bristles prevent the cleaner from working down while the collar is worn, and the tie will slide through it easily, without requiring any effort. A. SCHAAL.



A hint for those who wear turn-down collars

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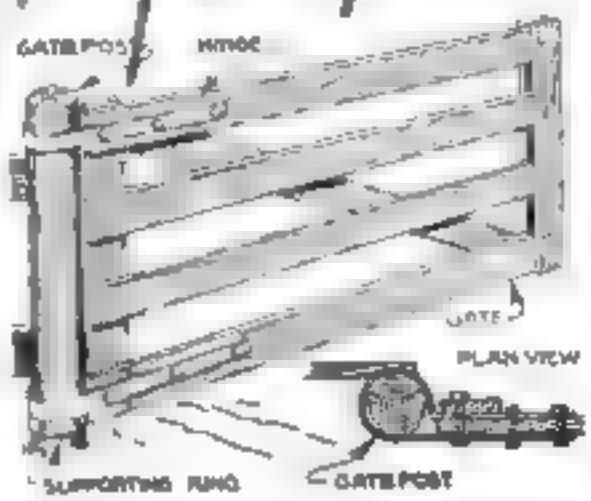
THE HOME WORKSHOP

Wide-Swinging Gate for the Farmyard

A GATE that may be swung through nearly 360 degrees may be made by using an offset ring-hinge such as is shown in the illustration. The one of the gate is on the opposite side of the post from the [illegible] of the fence, and the construction allows swinging the gate back against the fence on either side, which is often very

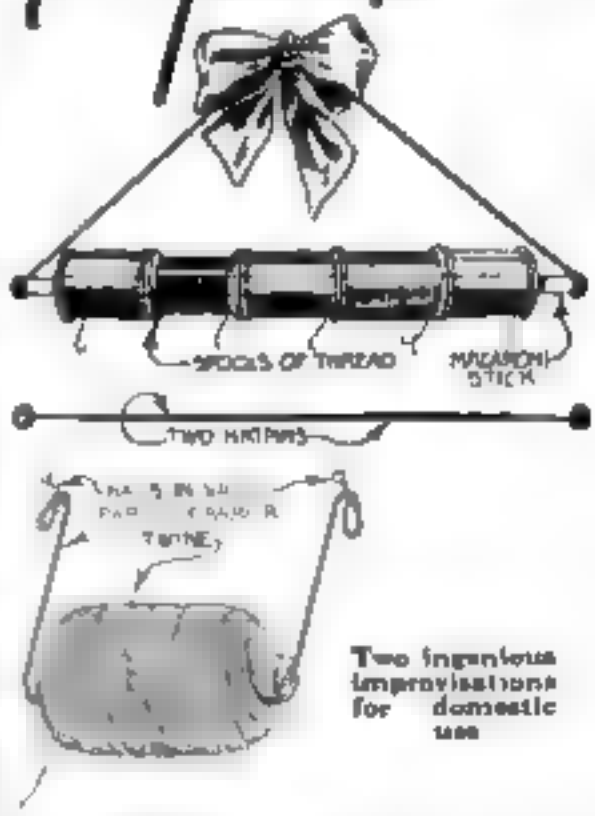


When swung open as far as it will go, this gate will be flat against the fence

desirable. The mounting below the lower hinge should be a solid ring, to allow of free rotation of the hinge upon it. The post used for a hinge-post should, of course, be round. The post on the other side of the gate should be so placed as to allow the gate to pass it if the maximum swing of the gate is desired.—LOUIS SCHNEIDER.

Novel Spool- and Twine-Holders and How to Make Them

THE spool-rack in the picture is made from a straight stick of macaroni and a pair of hairpins. When necessary to put on a new spool, simply pull out one of



Two ingenious improvisations for domestic use

the pins. It's so convenient to have all of your spools right at hand when sewing.

The other picture shows a single-spool holder made from one of the handles the grocer gives away for carrying parcels home. Keep some of them, for they make the handiest twine-holders. Always have one in a convenient place in the kitchen and laundry.—JENNIE E. MCCOY.

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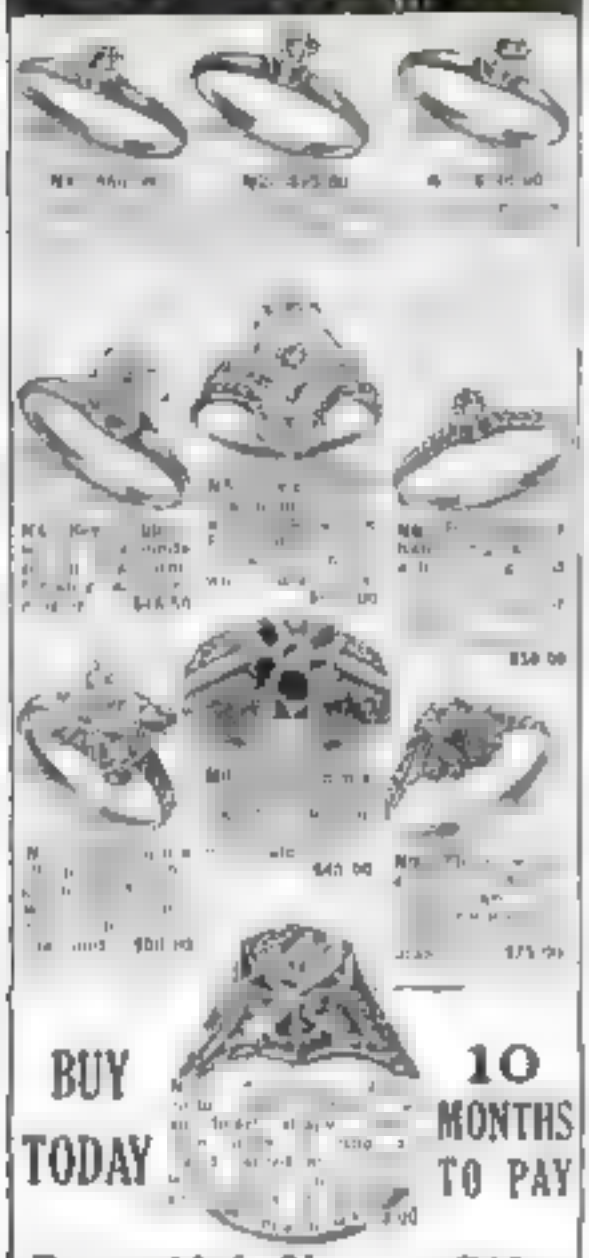

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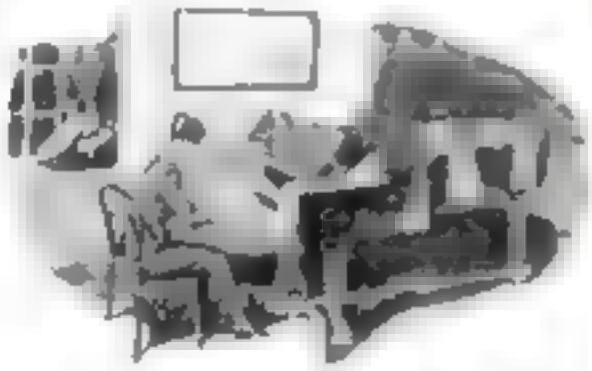
THE HOME WORKSHOP

Spinet is Transformed into Bookcase and Desk

ONE day, while rummaging in the attic, I conceived the idea of transforming an old [illegible] of [illegible] in [illegible] 9 in. [illegible] the first thing I did was to remove the keyboard and the mechanism in the interior of the instrument. Next I built into the fore part of the old spinet two sets of small drawers on each side and partitioned off a number of pigeon-holes of various sizes. Then the affixing of a hinged writing surface supported by two metal quadrants gave to the front of the former instrument the ordinary appearance of a comfortable writing-desk. Furthermore, by means of a pair of movable supports, I made the music-stand adjustable so that it could be lowered to serve as a convenient bookrest or raised to act as a lid for the desk by folding over flush with the top. The music-stand and writing surface met at right angles when closed, forming a firm protective covering and changing the article into a quaint library table.



What was done with an old spinet may suggest similar transformation of other old furniture

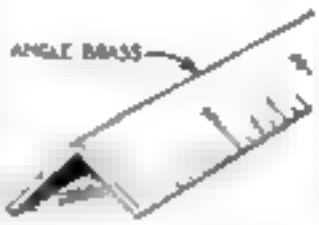
I divided the rear portion of the body of the former spinet into three parts for the storing of books. The volumes were put in with titles uppermost.

In addition, I fashioned a large drawer to be used for keeping papers, booklets, and the like in each side of the desk in such a way that they were wholly unseen. These drawers were opened by clutching them with the hand on the under side.

To open the combination bookcase, library table, bookrest, and desk, finally, one had but to touch a pedal of the former spinet, which released the catches holding the music-stand and writing surface in position.—L. C. GOBETZ.

A Convenient Ruler that Does Not Slip

THIS ruler consists merely of a length of angle-brass with ½-in. flanges. Select a smooth piece and finish the ends neatly and the job is done. If you wish, you may mark an inch-scale on it. Use the ruler with the corner up. It gives a hold for the hand better than any except the triangular ruler, and it has the advantage because it will not slip. For this last reason it is very useful for cutting where considerable pressure must be used.—HOWARD GREENE.



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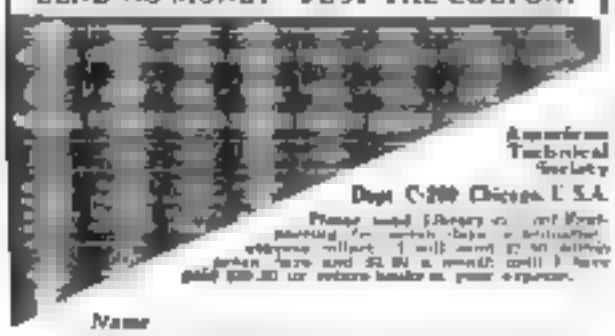

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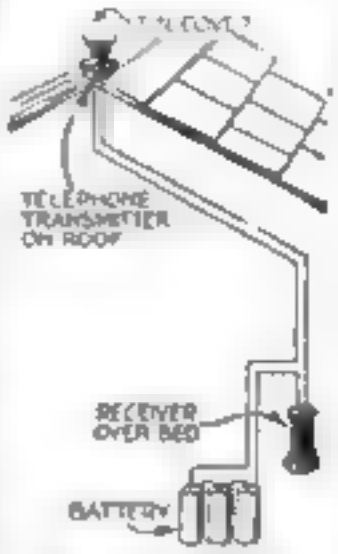
THE HOME WORKSHOP

Receiving Rain Warning by Telephone

SOMETIMES it is important to know when rain begins to fall in the night. One method of obtaining this information is to use a discarded telephone transmitter. Fasten the mouthpiece, mouth up to the roof or any convenient place open to the sky, and over it fix by the corners a sheet of tinned iron in contact with it. Then lead the wires to your bedside, where you will have the dry cells and the receiver part. The rain striking the tin will make a lot of noise which you will hear in bed.—E. A. McCann



The telephone will enable you to hear the rain falling

Here's an Ingenious Screw-Holder for Starting Screws

IT is sometimes necessary to start screws in a place that cannot be reached with the fingers. When such a condition is met with, the tool shown in the illustration will prove very handy.

A piece of [illegible] is used for the handle and rotter for a distance of about 1 in. at one end by sawing. An old alarm-clock spring furnishes the material for the fingers of the holder. A piece of this is doubled in the middle and forced into the slot in the handle. The fingers are shaped as shown and the ends squared by filing.

How to start screws in otherwise inaccessible places

To use the holder the fingers are pressed together and slipped into the slot in the screw. After the screw is started, the holder is pulled away from the screw.

One Method of Removing an Obstinate Staple

LARGE staples that are driven in deep or rusted in place are often hard to extract. This can be done, however, with the aid of a claw hammer.

Run a big nail through the staple and hook the claws of the hammer under the nail, the claws straddling the staple. Put a piece of wood under the hammer so that the surface will not be damaged, and then pull in the usual way. A very small staple, or double-pointed tack can be pulled in the same way with the claw end of a hammer.

This kink is well worth remembering

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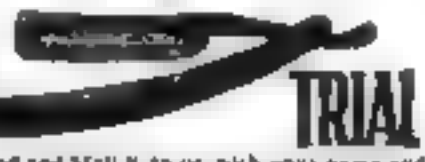

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The Last Discoverers

(Concluded from page 15)

plorer. The man who travels to the ends of the earth to-day is led by the hope of a discovery that will prove of lasting value to mankind.

For example, coal has been discovered in the region of equatorial Africa to which Carl Akeley sailed last August. This is the first good coal found in Africa. There are small lignite deposits farther south, but the lack of a suitable smelting coal has forced African miners in this region to float copper and zinc ore down the rivers to the coast and to ship this unnecessary bulk of ore across the sea for reduction. Now, in an area of which very little was known, we have found a coal-mine which will do much to make this section of Africa a great producer of metal.

A parallel case exists in British Guiana. The streams here have some gold in their sands, and occasionally placer-miners find a diamond. But where are the diamond "pipes"? An expedition has left the Smithsonian to look for mines, and its leader W. J. Lavarre, expects to remain in the jungles until he succeeds in this quest.

Geographical explorations such as Shackleton's and Colonel Bury's expeditions to Mount Everest, is drawing to a close. They have become a matter of clearing up details rather than preliminary surveys of totally unknown regions. The era of commercial exploration, such as the expedition of Lavarre and the oil prospecting on the Mackenzie have only begun, and in the future we can expect more and more work of this character. For instance, a few of the expeditions in the field to-day for scientific objects are the following. Dr. C. D. Walcott in the Canadian Rockies, Mr. L. H. Abbott in Chile, Dr. H. L. Shantz in Africa, and Mr. C. M. Hoy in Australia. The majority of modern exploration is purely scientific, but it must not be supposed that this "pure science" has no interest for the average man. It might seem as if the discovery of ten new varieties of beetle in South America, is a matter of little practical importance. But results which are at first "purely scientific" soon turn out to be of immense practical importance. Dr. Henry Rusby is now in the Amazon valley in search of rare plants—and to study noxious insects. Among the plants he expects to find medicinal remedies unknown to our present pharmacopeia, perhaps a medicine of such tremendous importance as quinine, which was brought back from these same forests by the early Spanish explorers. The study of insects may lead to the discovery of new serums for the treatment of dysentery and lockjaw, or the blotting out of tropical diseases, as his colleagues discovered the causes and the cure of sleeping sickness.

Few of us realize that modern research is like a pyramid—we hear of the peak, the culminating fact, that is recorded in the daily papers, but this is based on a long series of observations and data gathered by men scattered to the ends of the earth, working laboriously and unknown to fame in tropical jungles and frozen wastes. A scientific discovery is a synthesis of apparently unrelated facts gathered by many men, and these modern explorers at work at the points indicated on our map are really the advanced outposts of the army of science, and if the age of exploration for its own sake is drawing to a close, that of exploration for the sake of humanity has only begun.

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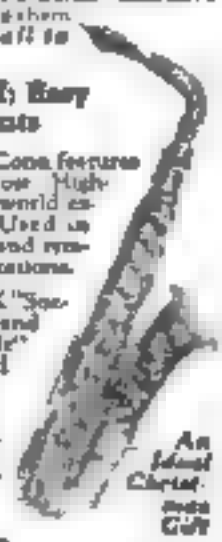

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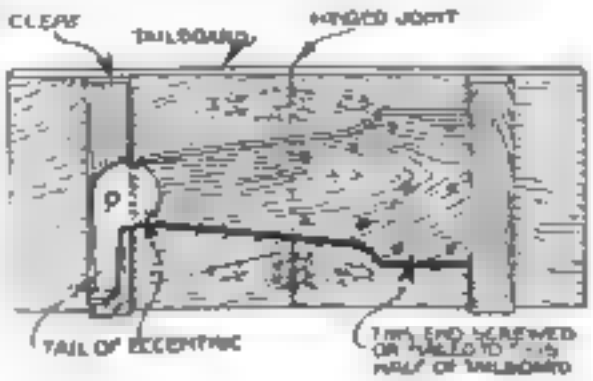
Hinged Tailboard with an Eccentric Lock

IF you are handy with tools, you can construct a hinged folding tailboard with an eccentric lock such as the one shown in the illustration. The lock is cut



Interesting suggestion for a hinged tailboard with an eccentric lock

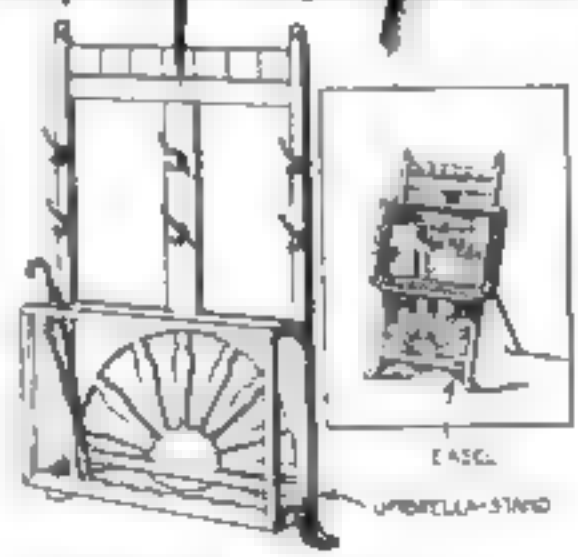
from a piece of flat iron stock, the lower end (or tail) being bent slightly outward to provide a handle.

The locked position of the eccentric is shown, the weight of the tail portion normally holding it so. When the tail is turned straight up, the catch of the lock is released, and the tailboard can then be removed.—LOUIS SCHNEIDER.

Hallstand Is Built from an Old Oak Easel

AN antique oak easel that had stood in the attic for a long time, was transformed into a hallstand as illustrated.

The stick at the back that supported the easel was cut to length for the umbrella-rack together with the strip on which the



This illustrates the transformation of an antique easel into a modern and useful hallstand

picture rested, the scalloped portion of which made edges for the bottom of the rack, which was the only new piece of wood required, and was stained with a dark oak finish to match the rest. Six ornamental brass hooks were added, and the result was a good-looking and useful article of furniture.—KATHERINE L. DANIHER.

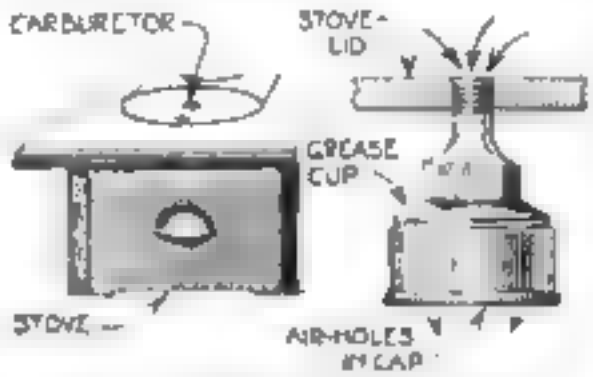
Try a Coal "Carburetor" on Your Range

THE object of the device is to save coal, which it does by mixing the gases created in combustion with air and burning them, instead of permitting them to go to waste up the chimney.

Manufacturers of several patented "carburetors" claim a saving of at least 20 per cent in the amount of coal used, besides complete combustion, giving a uniform heat, and burning the coal to a fine white ash without clinkers.

The one shown in the illustration has been thoroughly tested by several months' use on a kitchen range, and has given exceptionally good results. To make one, all that is needed is an old grease-cup (iron or pressed steel) from an automobile, such as is used on the Ford universal joint, two small drills, and a ½-in. pipe-tap.

Drill a hole in the center of the stove-lid and tap a ½-in. pipe-thread in it. Take



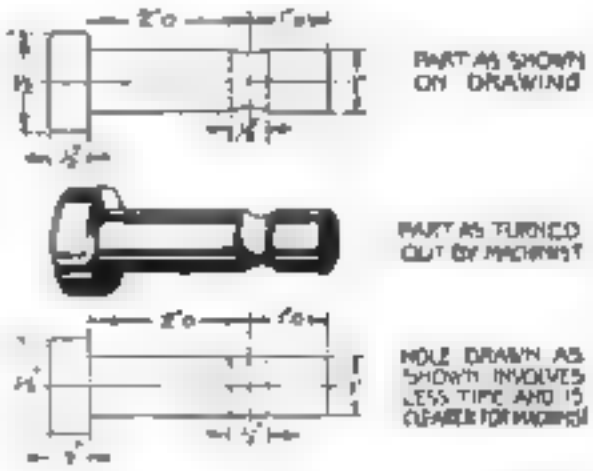
Try this coal-"carburetor" on your range and you will find that it saves coal

the top of the grease-cup and with a very small drill (1/60) drill, evenly distributed, about a dozen holes in it. Screw the cup together and then screw it into the tapped hole in the stove-lid. Your "carburetor" is now complete and ready to work, hanging inverted over the fire. Even better results can be achieved by attaching a carburetor to each lid that is directly over the fire.—E. B. DEIST.

Correct Drawing May Cause Error in Machining

OWING to the manner in which a circular drilled hole was shown on a detail drawing, as being cut through a circular bar, a machinist was misled to the extent of turning out a piece with a circular groove around the bar instead of the required hole. While the method of denoting a hole in the bar is correct as shown in the illustration, in accordance with mechanical drawing practice, also the dimension for the diameter of the hole, these details will invariably mislead the mechanic if he does not understand the projection.

A method for the draftsman that involves less work and is clearer to the ma-



Draftsmen can learn from this illustration how to make their drawings so that they cannot be misread

chinist is to leave off the circular lines at the ends of the holes. As a time-saver and for clearness, this is worth adopting.—G. A. LUERS.

How to Obtain Reflected Light for Indoor Pictures

THE amateur photographer finds that taking interior pictures by daylight is not usually a success. The ordinary living-room does not furnish sufficient light for photographic purposes even when a time exposure is used. The usual method is to place the subject close to a window so as to get the full benefit of the light. However, this always results in having one side

Amateur photographers will be able to take an indoor portrait by the use of this simple arrangement

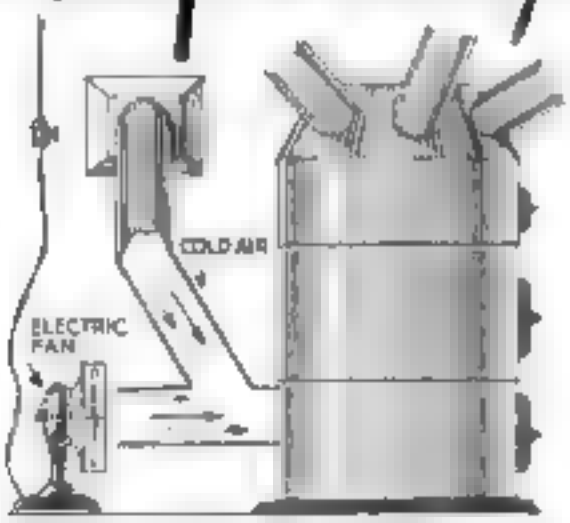
of the object illuminated, while the other side will be in the shade. This difficulty of proper lighting has caused many a camera lover to avoid indoor pictures.

By the use of a mirror properly placed, some of the light coming from the window may be reflected to illuminate the shaded side and thus help to procure more even lighting and avoid the defect of heavy shades and shadows. An ordinary sized hanging mirror so used will give surprisingly good results. A large piece of white paper with a glazed surface will make a good substitute for the mirror.

The picture and inset diagram show the arrangement. The best location and angle of the mirror can easily be determined by trial.—B. Fox.

Another Winter Use for an Electric Fan

AN electric fan need not be stored away in the wintertime, as it can be put to service in the way shown in the picture. It is connected with the cellar light-socket



The electric fan forces cold air into the furnace, thereby aiding fuel combustion

and placed so that it will blow air into the cold-air pipe. This assists the circulation of cold air through the furnace, aids the combustion, and increases its heating efficiency.—JOSEPH B. MORAN.

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Structural Engineer $4,000 to $10,000
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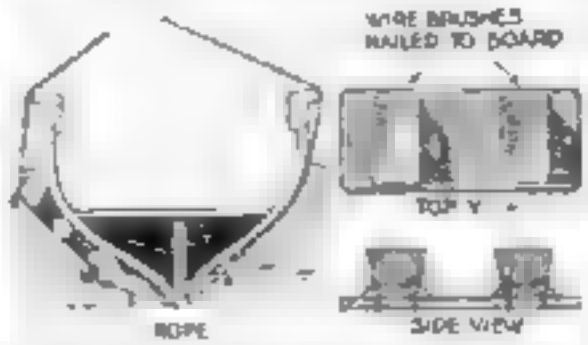
How to Clean the Under Part of the Boat Hull

A PRACTICAL method of cleaning the hull of a boat without hauling it out of the water is shown in the illustration. This device consists of two or three wire



Use this scrubbing-brush when you clean the bottom of a boat. It can be done without taking the boat from the water

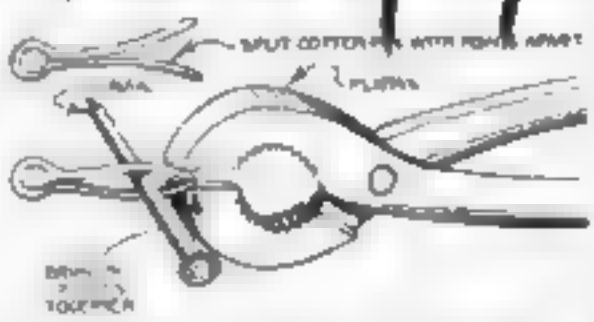
brushes fastened to a plank with a rope at each end of the plank. The rope is then thrown over the bow or stern of the boat and the owner or cleaner pulls it back and forth from above by means of the attached rope.

All of the marine growths, barnacles, etc. can readily be removed. The purpose of cleaning is, of course, to prevent decay and obtain better speed with the boat, as these accumulations hinder the boat's progress through the water.—G. A. LUERS.

Straightening Cotters to Bring Points Together

IN order to insert a cotter-pin into a cotter-pin hole after the ends are once spread, loss of time results unless the points are brought together.

The work should start open, unless

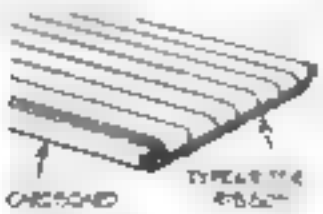


This little kink is a good trouble-saver, especially for the mechanic

they are bent in the opposite direction. To do this, place a nail between the points and press them together with the pliers.

Stamp-Pads May Be Made of Type Ribbons

OLD typewriter ribbons form very satisfactory rubber-stamp pads. Take a suitable length of discarded ribbon and find a suitable piece of cardboard cut to fit the pad-box easily. Arrange the loose end underneath, and secure with a drawing-pin or small tack, and place in box.



Save up your old typewriter ribbons and make this practical inking-pad

The top layer can be cut away instantly when clogged with dust and dirt exposing the clean inky surface beneath.

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Pulling Posts Is Rendered Easy by This Method

A U-SHAPED staple of heavy iron or steel is driven into a post near its base. If a rock or a log is now placed near the post, and a long pole or an iron pipe is placed on the rock and under the staple, sufficient leverage will be exerted to pull up the post. The staple has greater resisting power to bending when driven far into the post, than one or two spikes of the same thickness. Where a simple spike will bend under the strain, the U-shaped staple will not.

Such a staple can easily be made from odds and ends found in the junk-box. If it

One man can pull a post by this method. Try it and see how easily it will work

is undesirable to bend one, one can undoubtedly be made from some broken pieces of machinery or tools with the aid of a file.—E. BADE.

To Prevent a Saw from Sliding to the Ground

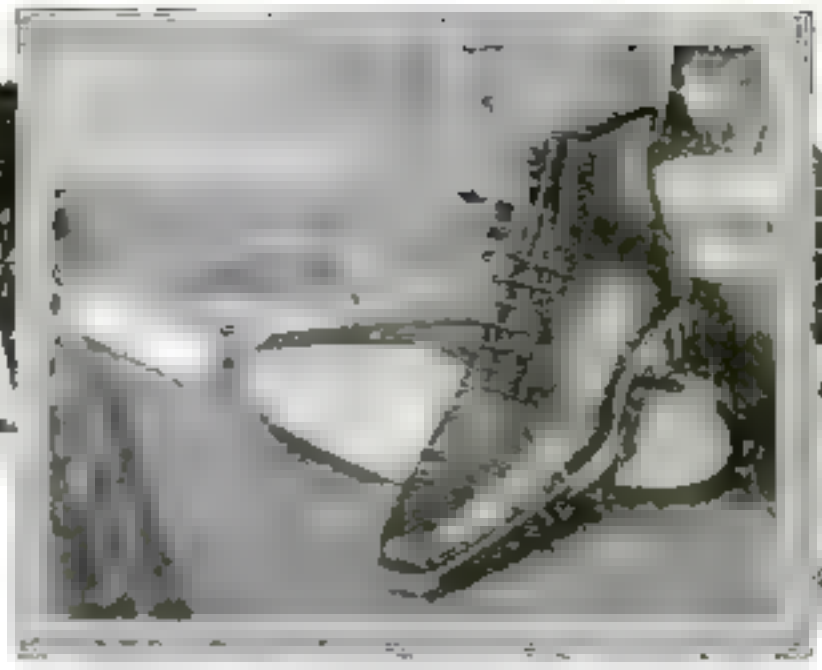
WHEN a man has considerable sawing to do, whether it is regular carpentry work or trees and branches to cut down in the woods, the ordinary saw must frequently be laid down.

On resuming the work the saw is picked up from the ground, which necessitates

When a saw falls, the teeth are apt to be injured. File these prongs on the end of your saw and lengthen its life

bending down, as often no place is available to put it on a higher elevation.

This constant stooping on a job that may last for hours is very trying and causes much fatigue. Invariably, when one attempts to stand the saw on end near the job, it will slide and fall. By cutting a V-shaped projection at each end as seen in the illustration, the saw will stand up without sliding.—ANTHONY E. ZIEPRICH.



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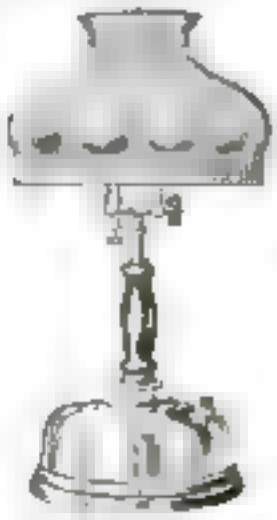

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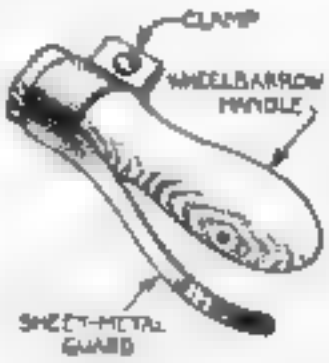
Attach a Hand-Guard to the Wheelbarrow



This attachment prevents scraped knuckles

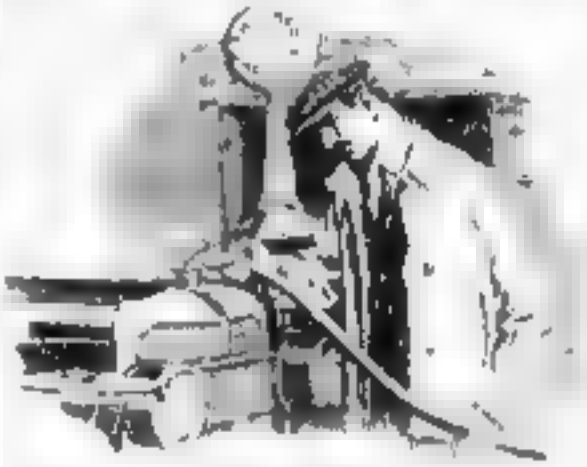
WHEN using a wheelbarrow near a brick wall or fence, the operator's knuckles are often skinned. Also many loads are dumped by the operator in order to save his hands. This means great loss of time.

The guard shown in the illustration will protect the workman's hands. It should be made of iron about 1/16 in. thick, and the part that protects the hand should be comparatively wide. The dimensions can best be calculated to suit the particular conditions.—S. E. GINES.

Handy Nozzle on the Hose for Filling Radiator

HERE is an improved way for filling the automobile radiator with water at service stations.

Attach a spring lever faucet to the end of the hose coupling as shown. The hose can be kept connected with the main all



The spring-lever faucet attached to a water-hose will save time and trouble

the time. All the automobilist has to do is to place the nozzle of the faucet into the filler pipe and then press the lever. The flow of water stops as soon as the finger pressure is released.—L. B. ROBBINS.

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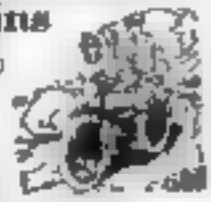

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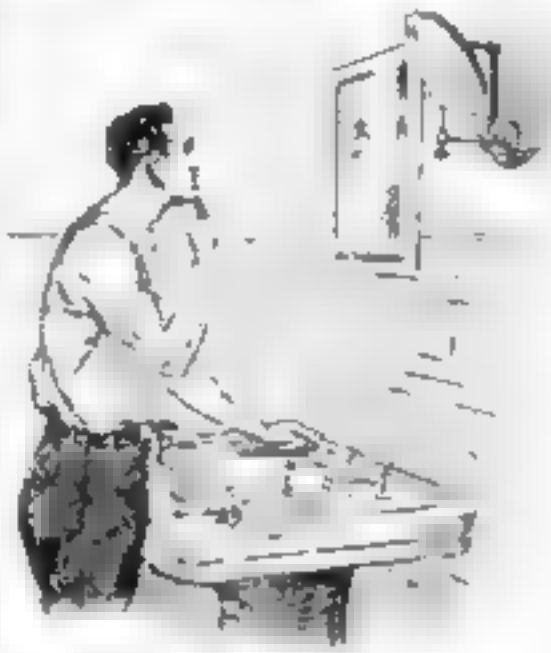
The pie-plate is lined with asbestos and is fastened, by means of small pipe lengths



Take the chill from rooms in the morning by using this simple heater

and joints, to the gas-jet. It is fastened in the position shown in the illustration. When the heat from the gas jet has heated the asbestos, the pie-plate should be inverted downward. The plate should be fastened so that it can be adjusted to any position.

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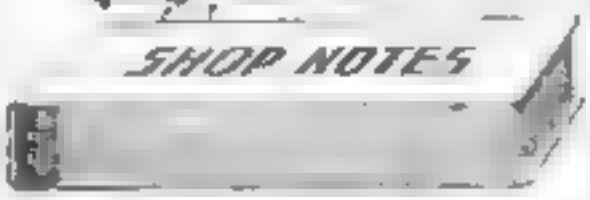

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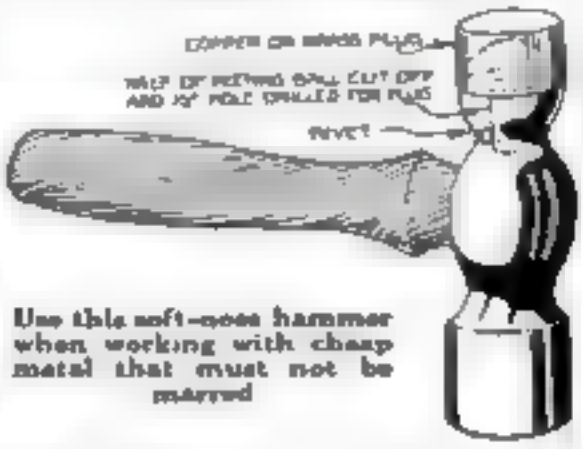
Providing a Soft Nose for the Peen-Hammer

A SIMPLE modification of a ball peen-hammer for purposes of driving in ball-races or for any other use where a brass or copper hammer is required, as on gears, is shown in the illustration.

For this purpose any hammer is suitable, even if the peening end is well worn and



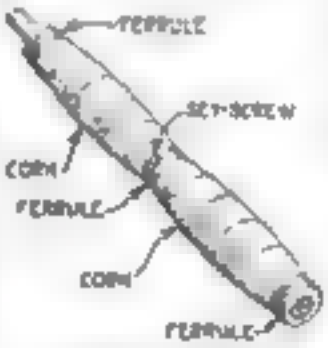
Use this soft-nose hammer when working with cheap metal that must not be marred

battered, as the ball must be sawed or ground off. A ½-in. hole is drilled in the end to a depth of ½ in. A copper or brass plug is driven into this hole and held with a dowel-pin drilled through at right angles. The soft brass or copper can be replaced as often as is required.—G. A. LUERS.

A Suggestion for a Cork Handle for Your Fishing-Pole

IF the cork handle on your fishing-pole is worn, below is described how you can make one at practically no expense.

Obtain three ferrules, or steel washers, and a number of large corks. Place one of the ferrules in position, put a few corks over the rod, fasten the second ferrule in place, then a few more corks, last of all finishing up with the third ferrule.



Add to the comfort of fishing by placing this cork handle on your pole

Shape the corks roughly by means of a knife and then sandpaper them to the shape shown. Such a handle is as good as any manufactured style, and is easily applied to any fishing-rod.—J. H. MOORE.

Try This Emergency Clothes-Line Pulley

WHEN a new ribbon is put on a typewriter, there is one roller left over. Don't throw these extra rollers away, they may be useful some day. One use for the old ribbon-holder is to make the pulley for a broken or worn clothes-line pulley.

A piece of cord is put through the hole in the center of the roller and then tied to the hook on the pole. If the knots in the line are too large to pass over the roller, they will either have to be made smaller, or the ends of the rope spliced.—A. GOLDENBAUM.

A new use for an old typewriter ribbon spool

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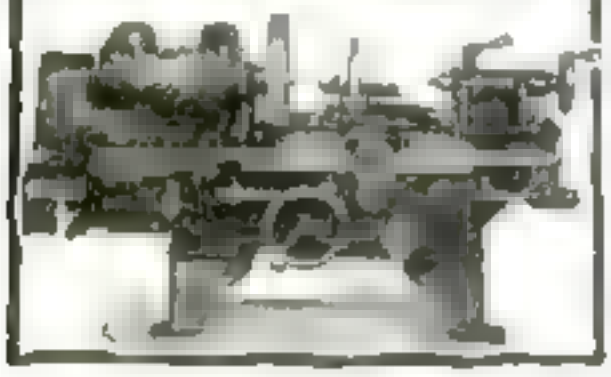

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How Leather Straps Can Be Made at Home

OFTEN it is necessary to have a few lengths of narrow leather straps as belts for model machinery. These can be made easily from any piece of available leather. Before it can be cut into strips, it must be cut into circular form.

The only requisites are a sharp knife and a small piece of wood. The knife should be as sharp as a razor if perfect results are to be obtained. The piece of wood used can be of any convenient size. One side must be perfectly flat, and this side is further prepared by cutting a mortise on one end. This mortise is cut to a depth slightly more than the thickness of the leather and of a width to which the desired strap is to be cut.

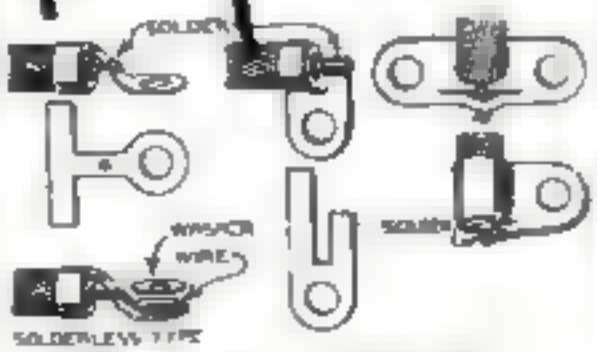
Then the knife is firmly driven into a board or into the workbench, and the circular piece of leather placed before the knife. The small piece of wood is placed against the knife, and the leather, which has first been cut a little so that a strip of it can be drawn under the mortise and held in the hand, is then gently but firmly pulled against the knife.

Small leather belts can be made easily when the leather is cut in this way

When the leather is pulled, it will be found to press against the mortise cut into the wood, and the knife will cut the leather as it reaches it. The leather will tear when the knife is dull.—E. BADE.

Do You Make Your Own Wire Terminals?

I HAVE seen so many people use the plain wire twisted under the binding-screw for attaching connections, that I thought I would describe a way of making your own wire terminals. By employing these connectors, there will be better electrical contact, the wires will not become broken, and the possibility of a short circuit is avoided. These connectors may be cut out of sheet copper or brass.



The amateur electrician will be interested in this suggestion

The illustration shows three types of terminals and does not require an explanation.—A. J. CHRISTOPHER.

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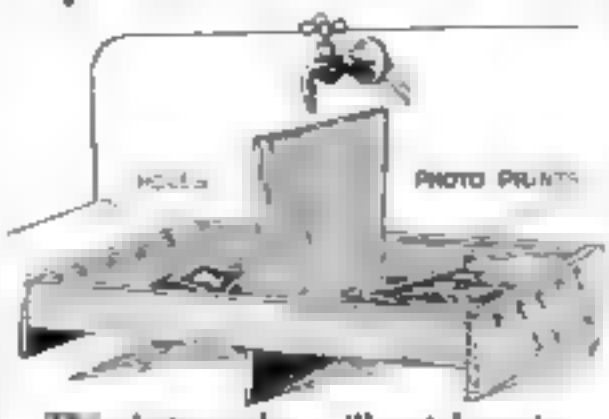
THE HOME WORKSHOP

This Photo-Print Washing-Box Rocks Automatically

I HAVE used with success the washing-box shown in the illustration for washing photographic prints. It is about [illegible] in. long, 12 in. wide, and 2 in. [illegible]. The rocker in the middle of box [illegible] in. high and



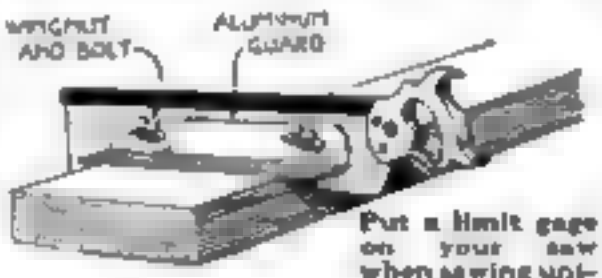
The photographer will not have to watch this washing-tray; it works automatically

bumpers on each end are about 1½ in. The center upright is about 10 in. high and is made so that it is watertight. Half-inch holes centered 1 in. below the top of the box, give outlet for the water. Place prints to be washed in each end and fill with water, place the box under a spigot giving a slow stream of water. As the box fills, first on one side and then on the other, the weight of the water will cause the box to rock as part of the water runs out of the lower end of the box.

Equip Your Tenon-Saw with This Guard

THE guard shown in the illustration consists of a piece of aluminum or other metal bent at right angles, the length and width depending on the saw length, and the distance from top to bottom depth.

Two slots are made about [illegible] from the ends. A couple of ¼-in. holes are likewise



Put a limit gage on your saw when sawing uniform grooves

drilled in the sawblade to admit small bolts. They are secured with wing-nuts.

After determining the depth of cut required, adjust the guard in position, and tighten the screws.

I find this device especially useful in cutting dovetails; the depth of cut always being equal, measuring is not necessary.

The accessory is attached or detached in a second; it may be applied on either side of saw, and does not interfere with its use for all-round work.—GEORGE H. HOLDEN.

Furniture Polish Renews Old Auto Window Lights

WINDOW lights that are hard to see through because of blurs and scratches can be quickly cleared up by rubbing them with a soft rag saturated with furniture polish. Simply rub them well and wipe off the dirt with a dry cloth and they will shine.—J. C. OTTOFY

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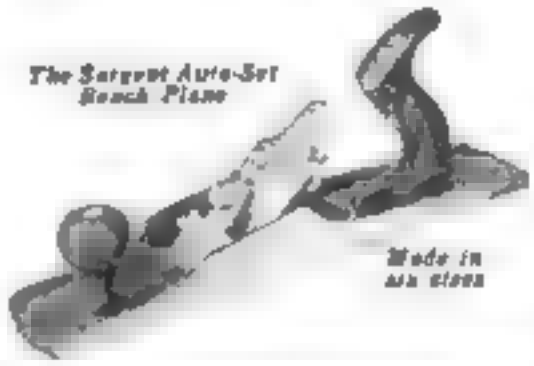

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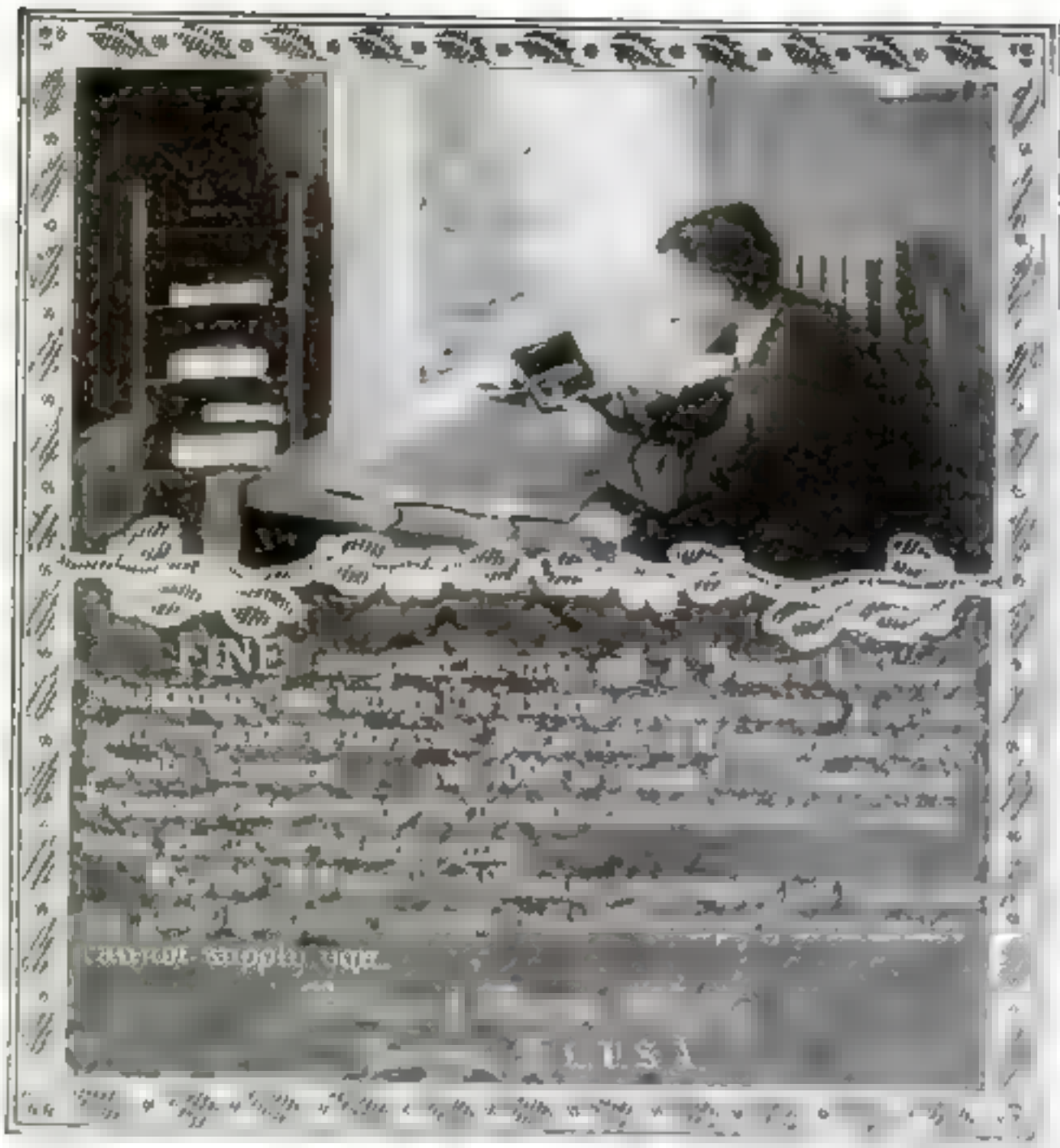
AGENTS



THE HOME WORKSHOP

Cats Can Be Kept Off the Back Fence

IF you are annoyed by cat serenaders on the back fence at night, an old Ford induction coil, connected as shown, will give the feline visitor something to remem-

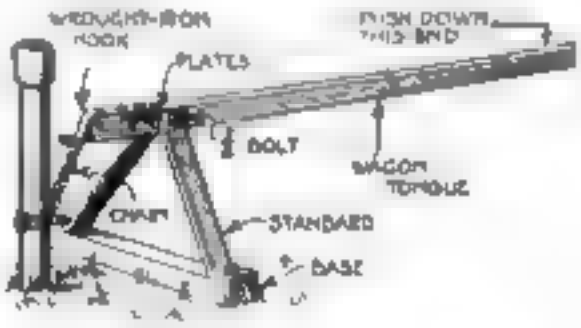
This small electric-shock outfit insures restful nights

ber. Two bare wires from the secondary of the coil are run along the fence top and when the cat on the fence it will naturally come in contact with these wires and using the saw will cause any cat to leave the vicinity abruptly.—J. B. MORAN

Pipe-Pulling Tool Is Useful on the Farm

TO pull a pipe from the depths of the earth is strenuous work, but here is a tool that will be a sure help.

Get a wagon-tongue and cut it about 8 ft. long. At the large end or butt, screw two steel plates to opposite sides and drill three holes through the plates and timber 6, 9, and 12 in. from the end. Holes should be ⅝ in. in diameter. Then have a blacksmith forge a large hook with a flat shank



Pulling pipes from the ground is difficult without the aid of a device similar to the one shown

and bolt this to the top of the tongue so that the hook lays over the end and down.

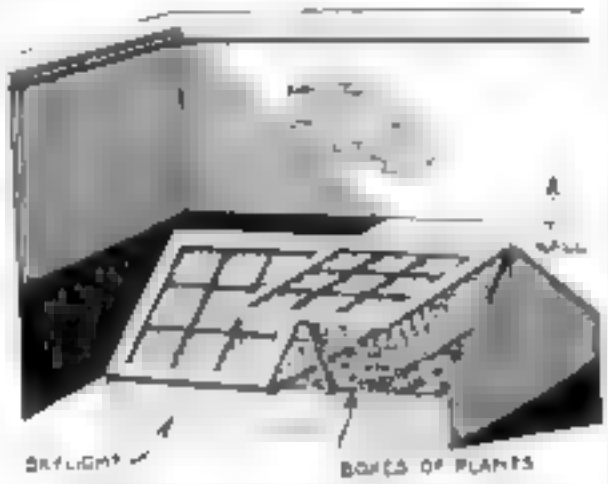
The standard is composed of three pieces of heavy strap iron bolted together in the shape indicated, with a hole drilled in the top of each piece to correspond with the holes in the tongue. Then the tongue is pivoted to any one of the three holes by a ½-in. bolt as a pivot bearing.

Set this lever so that the hook comes 2 or 3 in. from the pipe and wind a strong chain about the pipe a foot or so below the hook. Pull the turns of the chain tight, so that they bite the iron and hook a link at each end over the hook. This raises the far end of the tongue. Then, by exerting the weight of the body on the end of the lever, with the chain biting good, the pipe will come.—L. B. ROBBINS.

Skylight Serves City Dweller as a Hotbed

THE foreman of an assembly room had a fondness for gardening. One spring he converted a skylight on top of one of the shop roofs into a temporary hotbed. Supports were placed across the space beneath the glass and in these were set boxes of suitable size in which the seeds were planted. Needless to say, the plants thrived and were ready for [illegible] two weeks sooner than if they had been planted in the open air.

The skylight proved to be particularly appropriate since it faced the south and was protected on all sides from cutting



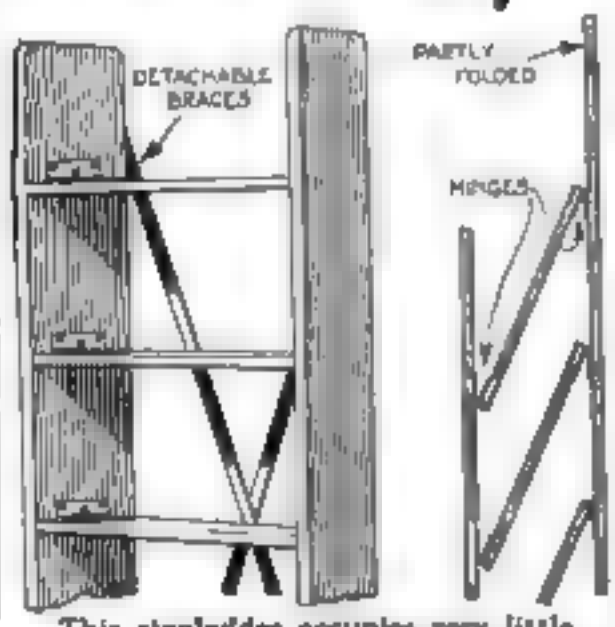
An idea for the city dweller who would like to have a garden

winds by a 6-ft. wall at the edge of the roof. The plants inside were spared any drop in temperature. Moreover, the heat rising from the rooms below helped the germination process.—D. R. VAN HORN

A Collapsible Stepladder for Home or Shop

STEPS are attached to the uprights by means of hinges. The [illegible] one side are on the upper side of each step, those on the opposite side are [illegible] the under side, as shown in the picture. The appearance, when not in use, [illegible] up at [illegible]

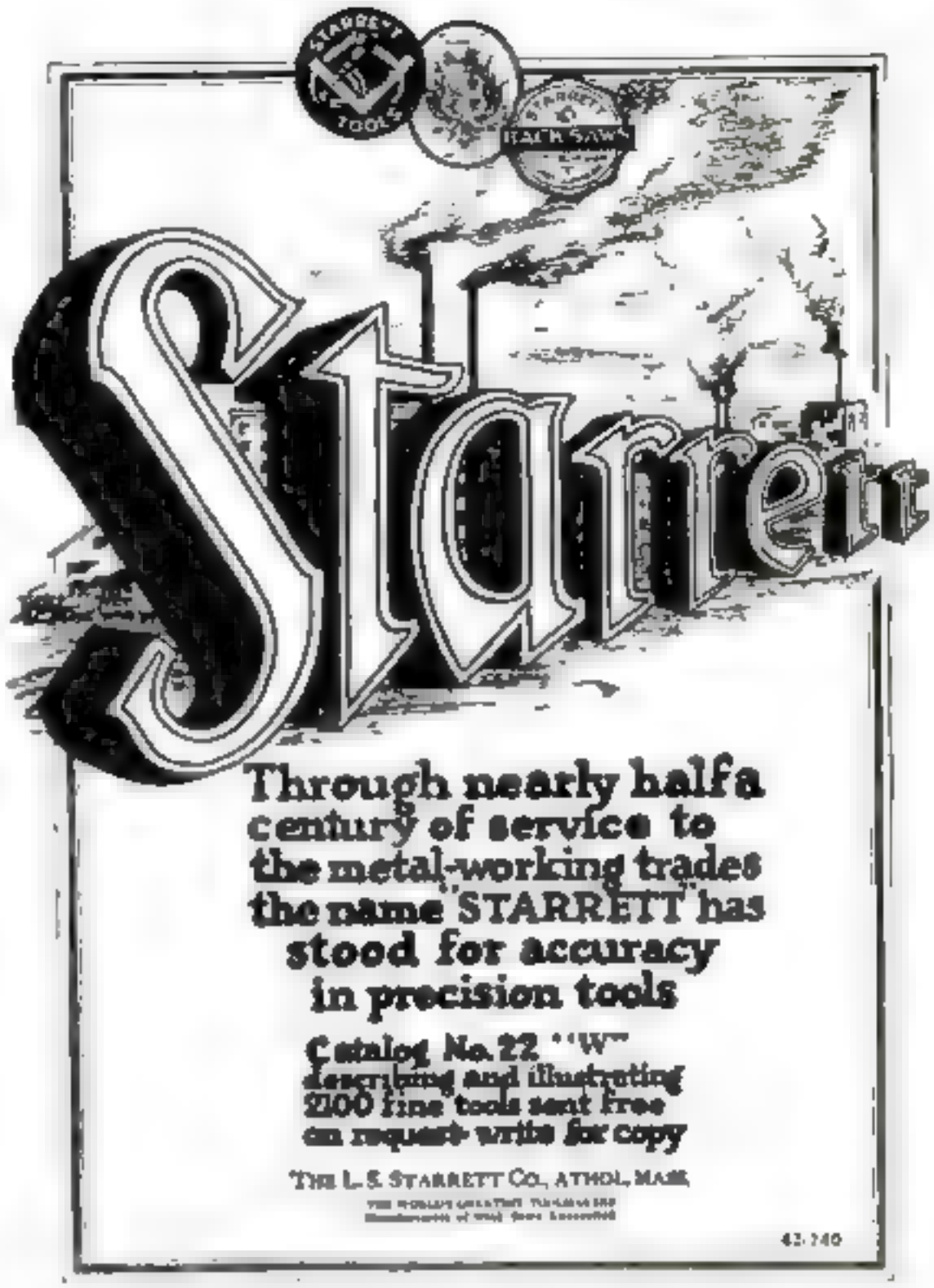
The two cross stays are of ½ in. [illegible] ½ in.

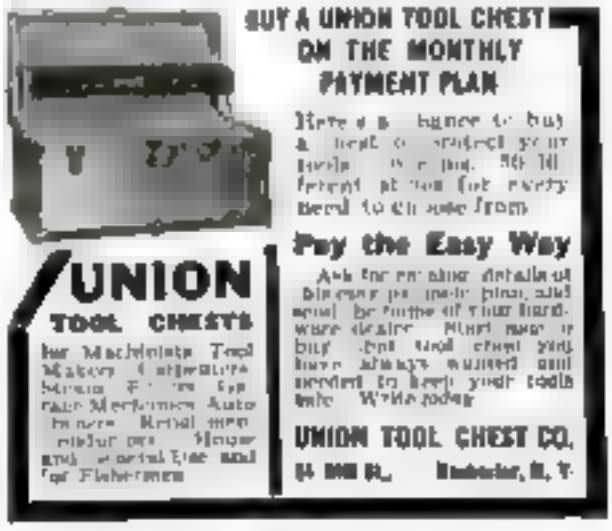


This stepladder occupies very little space when it is folded up

steel, secured at the top by a screw, the other end being held in position by a wing-nut and bolt. The stays will then be found to hold the ladder rigid during use.

Out of action, the ladder folds up to occupy a space about 7 ft. long by 3½ in. deep.—GEORGE H. HOLDEN.





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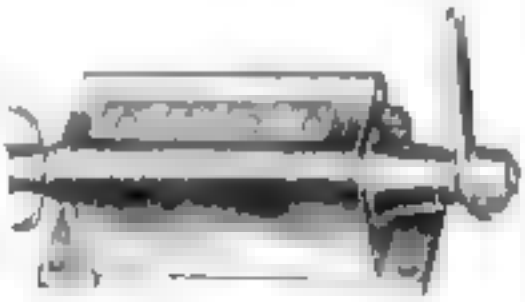

The above Revolution Set-Back Counter records the output of any machine where a shaft-revolution indicates an operation. Sets back to zero from any figure by turning knob once round. Supplied with from four to ten figure-wheels, as required. Price with four figure-wheels, as illustrated, $10.00—subject to discount. *Cut less than one-half size.* Set-Back Rotary Ratchet Counter, to record reciprocating movements as on punch presses, $11.50 (list). Smaller counters at prices down to $2.00.

The Hand Tally illustrated below is used for counting anything from number of people attending a ball game, to number of packages in an inventory. In the public place it counts *persons*; in the factory or store it counts *stock*; in the "open" it may count anything from cattle on a ranch, to poles on a telephone line!

Registers one for each pressure of the thumb lever; counts up to 10,000, then repeats. Can be set back to zero from any figure by turning knob once round. Size, exclusive of finger ring, 2 inches greatest diameter. Price, $5.00.

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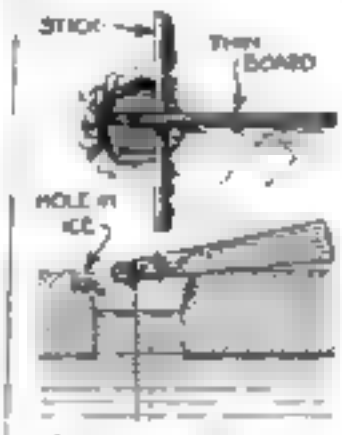
THE HOME WORKSHOP

The Tip-Up for Fishing through the Ice

WHEN a fish bites, the tip-up shoots up in the air, announcing that you have made a catch. At once you go to the hole, pull in the fish, and re-bait the hook.

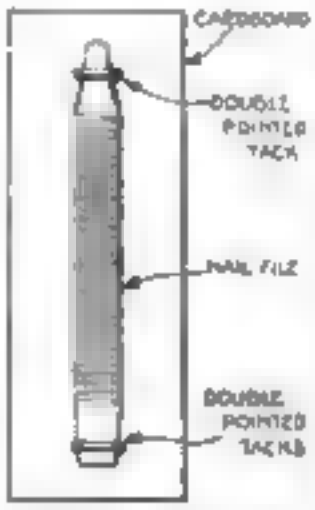
The tip-up is made [illegible] board and is about [illegible]-in. thick; the [illegible] a trifle thicker at both the small and large end. [illegible] in. wide at the small end and [illegible] in. at the large end. A hole is bored through this piece near the small end and through this a stick is fitted to lie across the hole. To keep the cross stick firmly in place it is well to sink it into a slit in the ice. Water can then be poured around the end. This will keep the stick firm and immovable, no matter how great a struggle the fish puts up.—ROBERT PAGE LINCOLN



When fishing through ice, use this "bite signal"

A Finger-Nail File Used as a Match-Scratcher

A DISCARDED nail-file can be made into a very convenient match-scratcher. Cut a piece of cardboard an inch or two wider and longer than the nail-file, place the file on it and fasten the file, together with the cardboard on the wall with two double-pointed carpet tacks. If you wish [illegible] may make [illegible] by placing [illegible] base and fastening the file in such a manner that it may be taken out to be cleaned and then put back into its place again.—WM. A. JACKSON

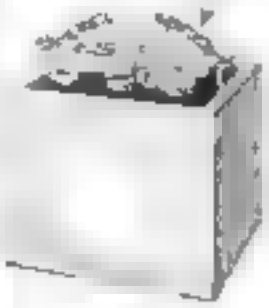


Don't scratch the wall when it can be prevented in this simple way

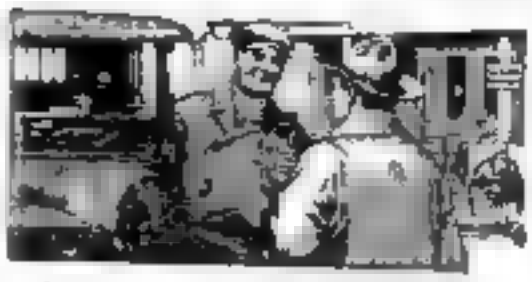
Carrying the Storage Battery with a Chain

ONE of the [illegible] from a discarded [illegible] used to advantage [illegible] the storage battery. Ha[illegible] or leather are not [illegible] length of time because they soon deteriorate and then give way under the weight of the battery.

The illustration at the left is self explanatory and clearly shows the manner of attaching the ends of the chain to the handles of the battery box.—WERNER STAAF



An easy way to carry batteries



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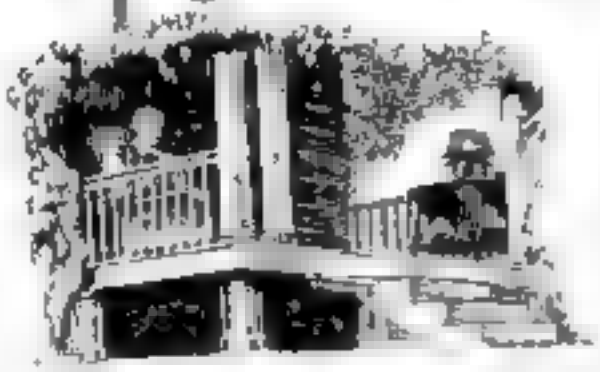
THE HOME WORKSHOP

Drainpipes May Be Used as Porch Supports

THE tile pipes for drains and sewers make strong and attractive porch supports. They are more economical than either stone or brick and are much easier to set up.

The pipe tile is 12 in. in diameter, is



A tile pipe makes a splendid porch support when used in this fashion

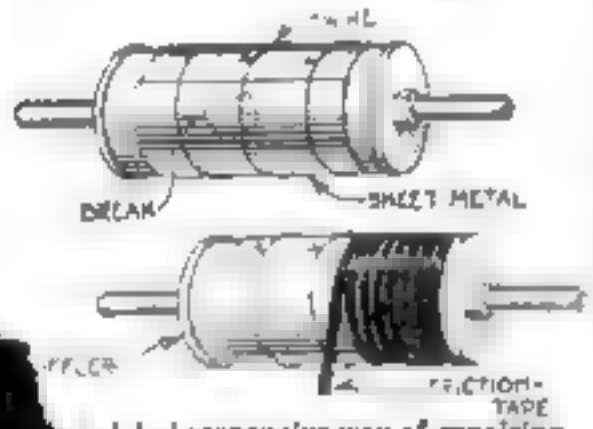
a good size to use. It can be made very much stronger by filling it with concrete. In case the tile should become broken, its concrete core will still support the superstructure.

The tile is set up with the flange end down on a stone or concrete base. By painting the pipes gray they can be made to resemble concrete very closely.

A Quick Repair of a Broken Muffler on a Motorboat

HAVING invited some guests for a ride, of course, the muffler on my motorboat blew out that morning. Not being able to obtain a new muffler that day, and not wishing to disappoint my guests, I proceeded to make a temporary repair.

The hole where it blew out was about 2 in. square and about in the center. A piece of galvanized sheet iron fitted around the muffler served as an outside cover. To hold the sheet iron in place I tied three loops of wire around it and tightened them



A quick, inexpensive way of repairing a broken motorboat engine muffler

twisting the ends of the wires with a pair of pliers. This gave it sufficient strength, but to prevent leaking, I wound the entire outside covering with friction-tape. On testing with the engine running, the leakage was only a few drops of water a minute. With this repair I ran the boat all day, and it proved very successful.

This temporary repair having proved so successful, I decided not to go through the trouble of putting in a new muffler. To insure against leaking, I painted the outside of the tape covering with a thick coat of white lead and when dry I wound another layer of tape over it. Another coat of paint completed the job. I used this outfit the entire season without the slightest trouble or a drop of leakage.—B. FOX.

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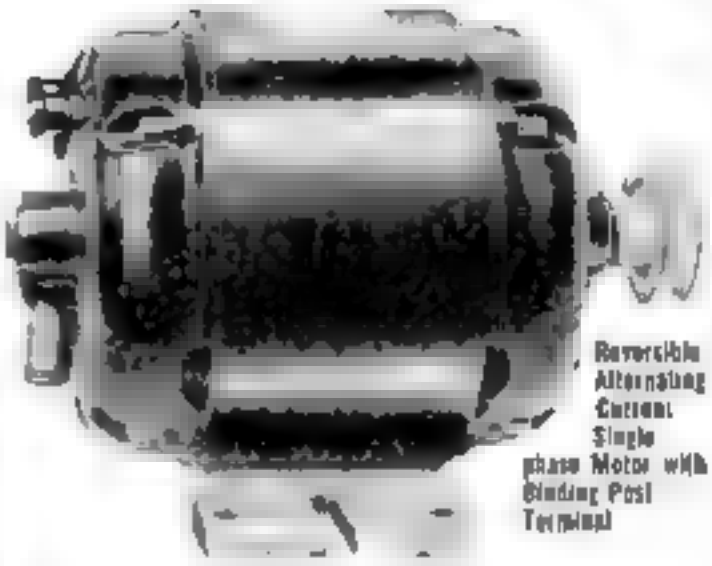

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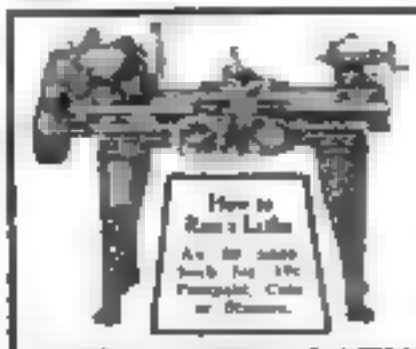

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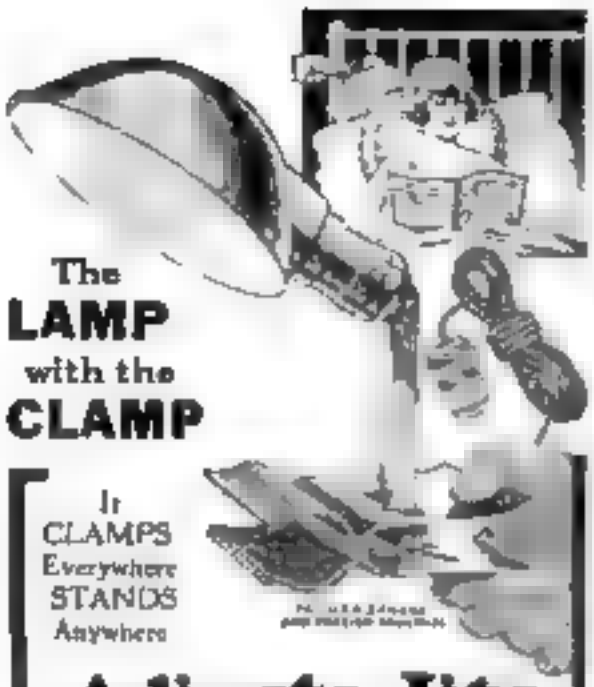

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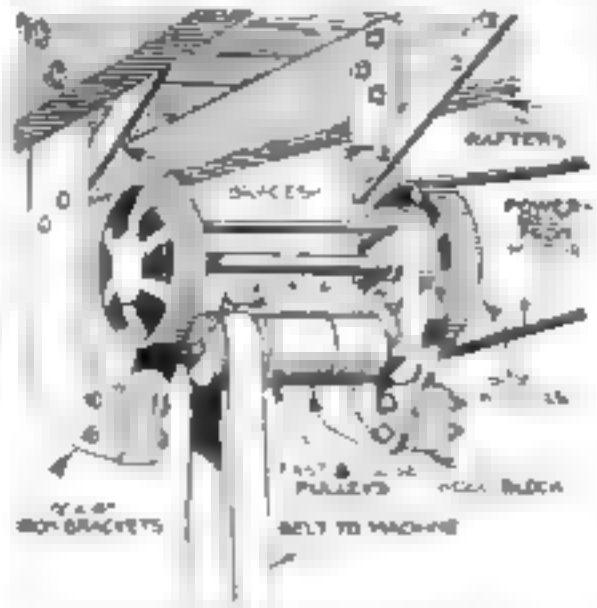
THE HOME WORKSHOP

The Old Lawn-Mower Becomes a Good Countershaft

TAKE one old lawn-mower with a 16-in. blade, which would mean 21½ in. over all. Remove the cutting-blades on the shaft and the wooden roller on the side extension castings. Put on the pulleys (iron if desired) and reassemble. Then



Use the old lawn-mower as a countershaft in your shop

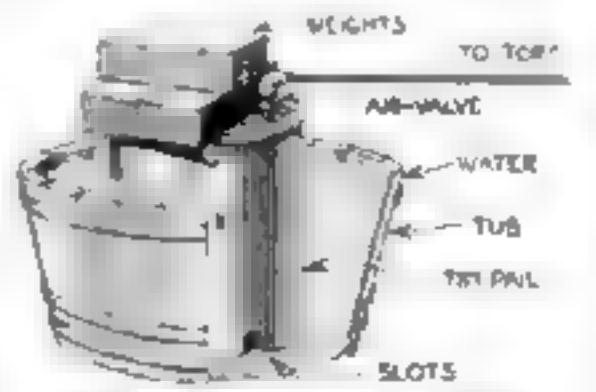
clamp the side braces on. These are bent as shown and braced and bleached.

The power belt is given over one of the 10-in. mower wheels, and drives the shaft at high speed, and the speed desired for operating the machine, etc., is obtained by putting on the right size wooden pulleys.

Two grease-cups are tapped in and the countershaft is made at an outlay of a very few cents.—P. P. AVERY

Pail and Tub as an Improvised Air-Compressor

FOR operating a small blowpipe a steady stream of air may be maintained by means of the improvised arrangement shown in the illustration. The device consists of an inverted pail, preferably a large lard-pail, in a tub of water. A connection for the air-pipe is made by screwing an old



This device will produce a slight air pressure that can be used in connection with the gas flame

tire valve or similar part on to the bottom of the pail. A slot at the rim of the pail permits the water to enter when the pail is inverted in the tub of water and forces the air through the hose. A suitable weight is placed on the pail to hold it in the water.

When the air supply is exhausted, it is simply a matter of raising the pail, which releases the water, and pressing it down into the tub again. This simple air-compressor is used by a local tinsmith in preference to a foot bellows or other pump, probably because of its inexpensive construction and unfailing operation.

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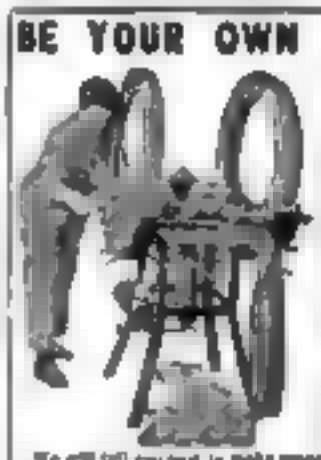

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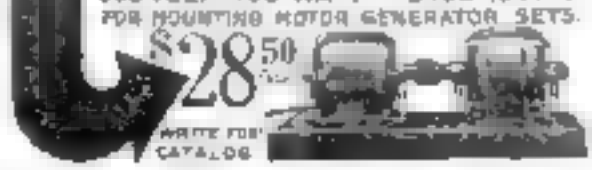

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This Sharpening-Tool will Concave the Ice-Skate

ONE of the best ways to sharpen a skate is to slightly hollow or concave it in the center. The depression runs the long way of the runner and it is difficult to make it accurately unless you have a tool to hold the round file. The picture shows one designed for this purpose and that will do the work well. It is pushed up and down the skate blade lengthwise, the motion being similar to that used by a carpenter planing the edge of a board.

You can make this device in a short time out of scrap material and it will serve you well for years. The wood used should be hard and sound. The top piece is 1 in. thick. The blocks between which the skate-blade fits are 1½ in. thick. They are screwed firmly to the top, or, rather, the top is screwed or bolted to them. The slot is larger where the piece of round file fits.

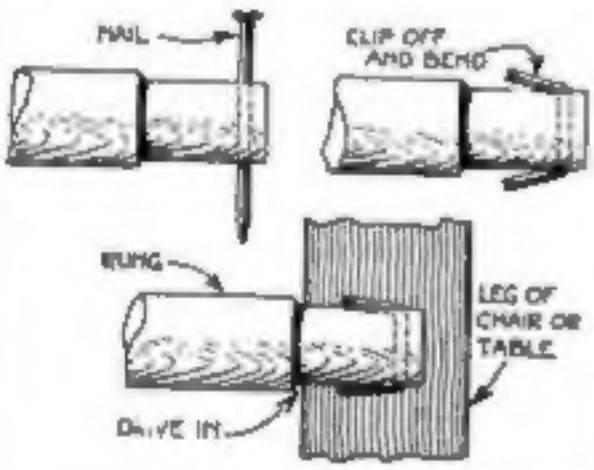
This method of concaving a skate-blade is simple

The file is held securely from slipping either way by a short bolt which comes down through the center of the top piece. The skate may be held in one hand while the tool is used, or it may be placed in a vise. The tool sharpens the skate in just the desired way and the file may be turned around at will or replaced when badly worn.

Furniture-Repair Kink for Holding Rungs and Legs

TO hold rungs or legs in furniture a simple suggestion is offered in the illustration. This prevents the rung from becoming loose, as it invariably does when glued in place without any fastening other than the glue.

The fastener is simply a wire nail driven through the leg or rung. After being



A good method of mending a chair runner or a broken chair leg

clipped off at each end with a pair of wire cutters, it is bent back enough to slant slightly upward at the ends. The glue is then applied and the rung or leg driven in flush. The ends of the nail are springy enough to open up slightly and catch in the wood. This method does not disfigure the wood as do nails or screws driven in from the outside. Cut the nail ends short enough to come inside the hole with the rung driven entirely in.—G. A. LUERS.

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